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AMERICAN MACHINIST

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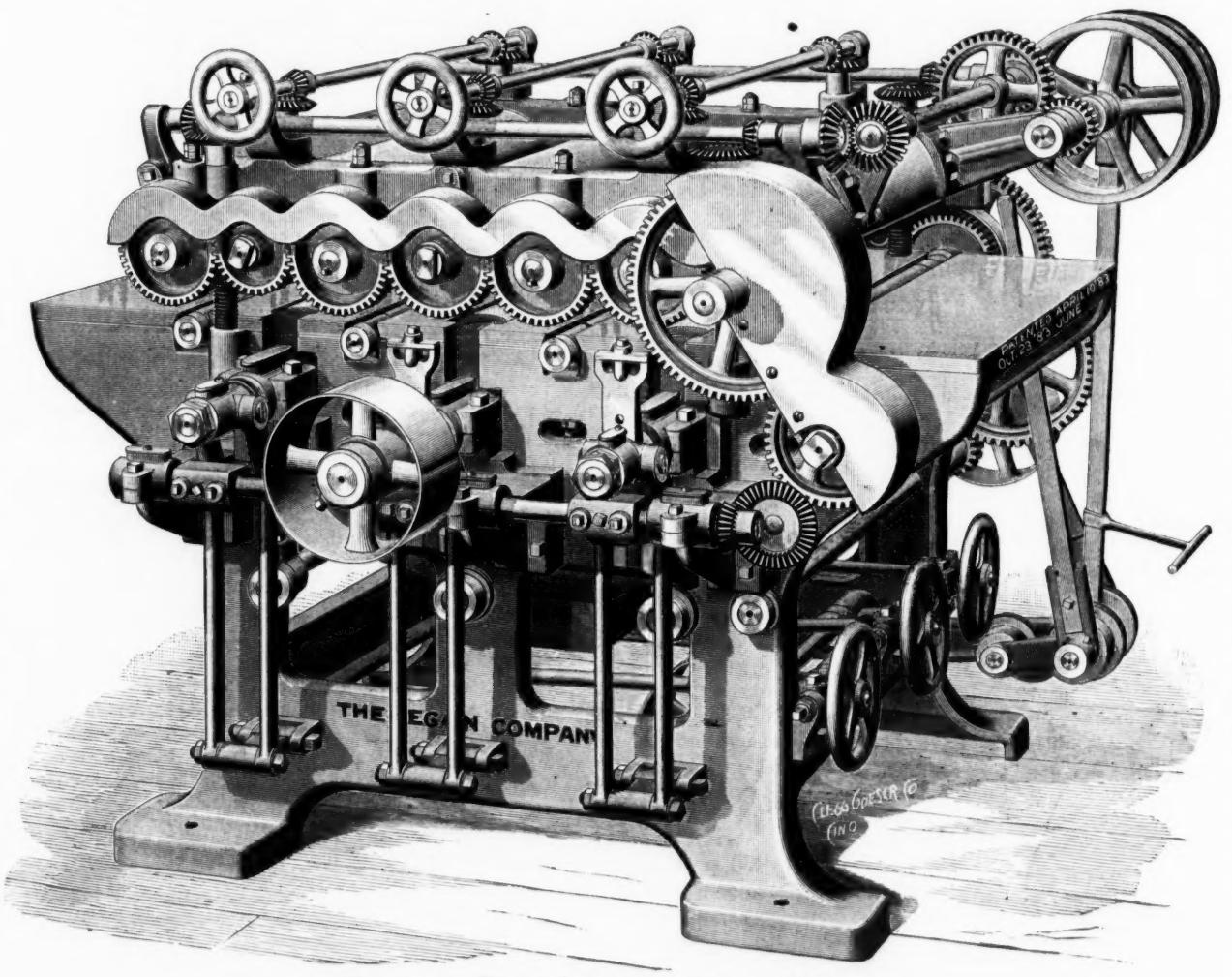
Thirty-inch Triple Drum Sand-papering Machine.

The accompanying illustration is of a sand-papering machine, which represents a full line of such machines from 30″ to 60″, made by the Egan Co., of Cincinnati, O. By the terms 30″, 60″, etc., is meant the length of the drum or the width of the work which is taken by the machine, the tendency at present being toward the use of comparatively wide machines, adapted to the modern system of cabinet and furniture manufacturing, in which parts such as panels or doors are framed and put together, then passed diagonally through the sanding machine.

It will be perceived that the machine is of substantial design, well adapted to absorb vibration, and it has all necessary features to facilitate the handling of the work. The feed is effected by eight feed rolls, which are of steel, so placed as to make the sanding of very short stock entirely practicable, all these rolls being driven by relatively heavy gear wheels. An improved system of expansion gearing allows the upper feed rolls to adjust themselves to admit stock varying in thickness from $\frac{1}{8}$″ to 6″ without attention, and when the paper is to be changed on the cylinders these upper rolls are moved out of the way by power.

There are three upper pressure rolls—one for each drum, and these can be adjusted separately by means of conveniently placed hand-wheels.



THIRTY-INCH TRIPLE DRUM SAND-PAPERING MACHINE.

The drums are of solid metal, provided with a single fastening device which holds the paper securely, and admits of its being tightened whenever desired. All are properly balanced and run on steel shafts provided with babbitted boxes. Any drum can be raised or lowered independent of the others from the working end of the machine without stopping it. Each drum is given a reciprocating motion in line with its axis, which, of course, conduces very much to smooth work. At the last drum is a brush, which removes all dust from the work before it passes under the last feeding rolls. The machine is well adapted to furniture, piano, organ, sash, door and blind factories, or to car shops.

It is a fact that a hot wave like that which has recently encompassed the country has a wonderful effect on productive industries. Men fail to work at all, or, working, cannot produce what they do in fairly cool weather; but, of course, work must go on at the best pace it can be made to go. It is pretty well understood that workmen in cool climates produce more in a given number of hours, but then they need more to sustain life, so that evens the matter, perhaps.

A Self-lubricating Fiber Graphite for the Bearings of Machinery.

Amongst the most interesting papers, in a practical way, presented at the San Francisco meeting of the Mechanical Engineers, was that by Mr. John H. Cooper, of Philadelphia, on the above subject. The amount of space at our disposal will not permit us to print the paper in full, but we make extracts from it as follows:

This material is the invention of Mr. P. H. Holmes, of Gardiner, Me. The inventor's object is to furnish bearings for machinery, upon which shafts will run without oil, or any added lubricant. Also to reduce friction and to render it more uniform, and thus by dispensing with applied lubricants, he would avoid the cost, all the inconveniences and dangers incident to their use. This material has been made by the inventor and applied during the last three years to machines in his own works and such as offered near by, as occasion presented; adapting it in some cases to much worn, grooved and damaged shaft journals. In all these places it has fulfilled the usual requirements of journal bearings, and has performed satisfactorily even where well-known and amply oiled anti-friction metals had been fairly tried without success. Many forms of bearings may be made of this material, and, since they possess within themselves the means of self-lubrication, the usual receptacles, channel ways and appliances for oil, and the distribution and delivery of the same to the bearings, are rendered wholly unnecessary. Experience thus far with this material has proven it uninjured by prolonged contact, even when under modern pressures and velocities, with water, oils, acids, alkalies, and to the ordinary higher temperatures; nor is it subject to change of dimensions by variations of temperature, as are the metals; the finished articles retaining the mold sizes with unusual precision, such that they can be used in machines with least tool fitting and finish. Revolving shafts, together with such parts of machines as have contact with motion, when properly fitted with these bearings may be run continuously without any more attention than is given to well-secured pulleys or to the shafting itself.

This bearing material is composed of selected, lubricative, natural graphite, which has been finely divided and freed from all foreign and gritty matter, to which is added wood fiber or other growth mixed in water in various proportions, according to the purpose to be served, and then solidified by pressure in specially prepared molds; after removal from which, the bearings are first thoroughly dried, then saturated with a drying oil, and finally subjected to a current of hot, dry air, for the purpose of oxidizing the oil and hardening the mass. When finished, they may be "machined" to size or shape with the same facility and means employed on metals.

* * * * *

The use of finely-divided, pure graphite, bonded by materials which of themselves are not unfavorable to anti friction, was almost wholly an untried experiment, and, judging from the rough attempts made to secure it, was certainly an unpromising and unsuccessful industry, until taken up by Mr. Holmes, who has, in the intervals of a busy life, performed much good and effective work in the making of solid, self-sustaining, and thoroughly self-lubricating bearings of these materials.

Mr. Holmes' efforts in this direction have finally taken industrial shape, with magnificent promise, in the production of a new and largely useful material, which has also been defined and formulated in several broad-claimed patents lately granted and secured in all the manufacturing countries of the world.

Graphite in a condition of powder and used as a *solid lubricant*, so called, to distinguish it from a liquid lubricant, has been found to do well where the latter has failed. All book references to graphite as a lubricant are meant to be the powdered form. Of such, Rennie, in 1829, says: "Graphite lessened friction in all cases where it was used." General Morin, at a later date, concluded from experiments that it could be used with advantage under heavy pressures; and Dr. Thurston found it well adapted for use under both light and heavy pressures when mixed with certain oils.

"Tests of graphite made at the Stevens Institute," says the AMERICAN MACHINIST, thirteen years ago, "demonstrate conclusively that this material, when *free from frictional impurities*, of the *proper quality* and *properly prepared*, approaches nearer the point of perfection for general use than any other lubricant."

There is, indeed, no question to-day among practical engineers as to the superior efficiency of pure and finely divided graphite for lubricating purposes, when used with oil through the usual channels established for such methods of lubrication.

Graphite is a native form of carbon, and occurs in fine-grained and foliated masses. It is the purest carbon known next to the diamond, and is capable, as claimed by Dixon, of finer division than any other known substance. It resists the attack of all acids and alkalies, is very incombustible, burns with difficulty even before the blow-pipe, and

therefore is much used for melting-pots which withstand a great heat. It has a specific gravity about double that of water. It is too soft to strike fire with steel. It has a grayish black color, metallic luster, is perfectly opaque, and has a greasy feel to the touch. Its unchangeable character and extraordinary smoothness fit it admirably for lubricating purposes.

It is difficult to conceive of the existence of such a material as this solid fiber graphite; we have become so accustomed to the constant necessity of applying lubricants in some shape or other to all wearing surfaces that we at once question the possibility of running machinery without them. This material fairly promises to supply the long wished-for final element necessary to perfect machinery.

* * * * *

The first requisite for any shaft and metal bearing is that they shall be truly cylindrical, and next that they shall be smooth, with enough difference of diameters only to permit of expansion without seizing contact, and to permit the flow of the lubricant to every part of the frictional surfaces.

During motion, a statement of results may be properly quoted from an address of Prof. Denton, who says: "Interruption of the uniformity of the intervening film of lubricant between the rubbing surfaces is a certain, and probably the far more frequent, direct cause of abrasion."

The "abrasion may result from the gradual and inevitable variations of smoothness due to metallic wear."

These niceties of fit and finish and maintained thoroughness of oil supply are not necessary for fiber graphite bearings.

The bearing of a shaft to be effective should permit of a certain amount of yielding to the pressure imposed; this idea is conveyed by the original name of "pillow block" which has been given to it; of this quality, Prof. Denton says: "If the brasses are lined with some of the soft anti friction metals, the crushing down of grooves by a smooth journal does not cause excessive friction. Herein lies the true advantage of these metals. The chances of heating are less with soft, anti-friction metal than with bare brass or hard white metal."

To this valued testimony may be added the deductions of Dr. Dudley, of the Pennsylvania Railroad, who says: "Those alloys which may be called softest give the best wear; that is, they lose less metal under the same conditions than harder or more brittle alloys."

Here, again, we have striking correspondencies of character in graphite to meet the wants of frictional contact; notably there exists a yielding surface, the finest granular structure, sufficient tensile strength to support the shaft when turning, and, better than all, the reigning supremacy of effective lubrication.

We have a statement by letter from Mr. Theo. N. Ely, General Superintendent of Motive Power of the Pennsylvania Railroad, to the effect that "the wear of the bearings, approximately, is about one pound of metal worn off for every 25,000 miles the bearing goes. The wear of axles is about one-third as fast." Introducing other data for comparison of values, a deduction has been reached, which shows the aggregate cost of metal wear of axle journals to be six times the amount of money spent to lubricate them. And again, the cost of the coal burnt for overcoming their friction is double the cost of their lubrication.

When considering the running expenses of any machine, and when considering also the relief to be afforded in the matter of lubrication by the introduction of graphite bearings, we must not center our minds solely upon the cost of and losses by the use of oil, but must estimate carefully the power cost and the metal wear and waste from these vital parts of the machine.

On the other hand, the uniformity and permanence of graphite friction qualify it for service in the construction of many instruments and machines, where the element of friction is an important factor in the unfailing performance of the same—as, for instance, in tower clocks, revolving ventilators, aeromotors, and machines exposed to sun, air and dampness, and especially where the same are inaccessible.

All that has been said about the bearings of machines in general will apply with equal force and scope to steam engines, but in these no conclusive experiments have as yet been made. The writer is aware of experiments in the lubrication of steam cylinders and valves of the ordinary construction and adaptation for oil, in which fine graphite was inserted through the ordinary self-feeders to the working parts within, with first-class lubricating effects, in addition to which the joints and whole interior of the steam apparatus were protected and preserved.

The continued wear of a car axle means rejection of the same in time, if not disaster and what a sense of relief it would be to feel that the cause of this dangerous weakening is removed to a greater distance or wiped out altogether! Graphite promises well to do this, as has been demonstrated by experiments with ordinary shaft journals.

There are many incidents, more or less serious and expensive in character, which appertain to the location, use and attendance of machinery fitted in the usual way with metallic bearings requiring oil. With many machines and manufactures, cleanliness is not only desirable, but also essential. There are many factory floors upon which it is not safe to walk nor profitable to place goods, owing to the great spread and flow of wasted oil. The additional expense on a machine of fitting it with oil cups and oiling devices would go far towards the whole cost of graphiting the same. The risk to life and limb of those whose business it is to oil shaft bearings and ceaselessly look after them would be well-nigh abolished.

* * * * * *

Mr. Holmes has run a set of twenty-five cotton spindles, continuously, as a shop shafting runs, during a period of nine months, in the usual way, as in a factory, which on test showed on closest examination no signs of wear either of the bearings or of the spindles. They were run at speeds varying from 9,000 to 10,000 revolutions per minute, and the greatest heat developed at any time was very little above that of the human hand. Tests were made to ascertain the difference in the power required for driving the Rabbeth form of spindle fitted with fiber graphite bearings, and the same spindle with bearings of metal and supplied with oil. Three persons, at different times and places, made in all 128 tests of each, using the Emerson Power Scale applied to the drum-shaft, which directly drives the spindles. The oil used in the Rabbeth spindle was obtained from a New England mill agent, and was given from their own stock of the best used by them.

The tests showed a clear average saving of 25 per cent. of power by the graphite spindles over the oiled ones—the lowest percentage in the series being 17 per cent.

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The fire risk, due to the use of metal bearings and oil, involves a large item of loss and expense.

Mr. C. J. H. Woodbury says: "The losses by friction and spontaneous combustion of oils exceed those from any other cause; from an experience of twenty-nine years, 37 per cent. in amount of damage is attributed to these sources alone."

The spontaneous combustion referred to applies to the use of oily rags or "waste,' which have been carelessly discarded after wiping the used and unused oil from machines which had been applied to the bearings and *at them* for lubricating purposes.

Mr. Woodbury also says: "Oily sawdust is fully as liable to spontaneous combustion as oily waste." And this statement will include the cause of at least some of the fires in wood-working establishments where the machinery is supplied with metal bearings which are lubricated in the usual way.

When used as a step bearing in water upon which a loaded vertical shaft runs, it is proven that 300 pounds may be supported in revolution at 470 turns per minute, upon an obtuse-angled cone two inches in diameter, which is the equivalent of 100 pounds per square inch of surface covered, in which case the tool marks were not all worn out nor any detrimental effect of submersion or abrasion observed after three months of running.

As to the effect of grit steam and dust in the atmosphere about and around these bearings, the Messrs. Holmes, three years ago, fitted five of them to the shafting in the charging house of their foundry immediately under the coke loft, which must be considered a very trying place to put bearings, but these continue to run satisfactorily without oil, heat, or attention.

A practical machinist in Auburn, Me., says: "Every one of the Holmes boxes that has come under my observation has been a perfect success in the following particulars: They have run dry without heating, they have required no care, they have not worn the shaft and in sixteen months' trial have not shown any wear themselves."

The overseer of the spinning department of a mill in Lewiston, Me., says "that he had run a spindle fifteen weeks, and during that time he had drawn a new driving cord upon it every morning as hard as a strong man could draw it, and that it had not worn any, but is precisely the same as when he started it. He determines that it has not worn by means of fitting a follower into it that exactly fitted the bushing before it was used. He was amazed that treatment so severe did not destroy it."

* * * * * * *

The Philadelphia Traction Company have used these bearings under the idler sheave shafts for supporting their cables in the conduits under the streets. Under date January 13, 1892, Chief Engineer Ely writes: "These are subject to the hardest usage. Part of the time they are submerged in water. They have been in use since last September, and are as good as when first put in. These bearings have not received any special attention."

* * * * * * *

The writer has taken a hand, during the past few months, with the inventor, in the development of this anti-frictional material, and is fully prepared to formulate and present the following well-considered conclusions.

With fiber graphite bearings properly prepared and fitted to the supports and journals of machinery, the cost of oil, together with all the appliances necessary to store, retain, convey and conduct the same to the bearings is entirely saved.

No wearing of the shaft journals has as yet been observed, and very little abrasion of the bearings has been reported by those who have used them.

During the first revolution of the shaft its concavities are filled with graphitic particles which are worn off the bearing by its rubbing action upon it. When the surface of the shaft is completely covered and evened up upon its whole exterior, the sliding will be conducted thereafter wholly upon the newly-formed graphitic surfaces, to which even the disengaged particles of the bearing will assist in lubrication; friction will in consequence be reduced to a minimum, and the shaft journal will be protected from subsequent wearing.

If we start with roundness of shaft and if we grant a certain roughness of surface, the journal after running a short time acquires smoothness by borrowing material from the bearing upon which it runs, and simultaneously fits itself the closer thereto, for its better support and running, after which the motion is all conducted upon the original and upon the acquired graphitic surfaces, with a measure of friction due to the natural lubricity of the graphite used, and without added lubricant of any kind or any attention whatever.

The labor of cleaning and oiling, and the cost of waste and wiping are saved, the soil-greasing of fabrics, machinery and buildings cannot happen, and the serious danger of fire from lubricating oils, and the spontaneous combustion of them with discarded waste, are wholly removed.

The making of these bearings, much of it having been done by rude and hastily designed tools and appliances, has amply proven that the cost of them need not be *above* and may be *below* the cost of metal ones which they replace, leaving a very fair margin of profit to those who, with superior machinery and appointments, engage to manufacture them, while the user is spared the cost and nuisance of oil and oiling, and in addition thereto is saved much of the cost of renewals as well as the anxiety which ever attends the use of metallic bearings.

A peculiarity of graphite bearings, which may have great value in the arts over the usual materials now employed, where sliding is involved, is that its friction at starting of motion is about the same as its moving friction. This property will enable the engineer to reduce the gross allowances for power to a minimum, when arranging for and providing the machinery of transmission, in cases where graphite replaces the usual metals with lubricants for bearings.

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The paper was presented by Mr. Charles N. Trump, of Wilmington, Del., who, after reading it, said that he had had opportunities for examining a great many of these bearings, some of which had been in service from six to twelve months, eight and ten hours per day, and might be able to answer questions if propounded. In answer to such questions he said that the graphite was very finely pulverized and purified from all gritty matter, and mixed with the wood pulp with water, the proportions of the graphite and wood pulp being varied to suit the service to which the bearing was to be applied. The mold in which the bearing is made is usually of brass, with grooves on the outside, and small holes, possibly $\frac{1}{16}''$ diameter, and with a space of about $\frac{5}{8}''$ apart. This mold is inclosed in a heavy case made of a steel casting. The mixture is pumped into the mold with a hand-pump, and the whole thing is then put under a hydraulic press, a follower put in, and the mass compressed to about one-third of its original bulk, the water flowing out through the little holes and along the grooves in the outside of the brass mold, from whence it runs off. The piece is then removed from the mold and simply dried in an oven; after drying it is saturated with linseed oil, and baked so as to be thoroughly hard. You can cut any of it; and some of it, having more wood pulp than other specimens, is a great deal stronger than that which has a smaller proportion of wood pulp. I have seen some eighteen or twenty bearings on an ordinary $1\frac{7}{16}''$ shaft that had been in use for over a year running eight to ten hours a day, as we ordinarily run in machine shop practice, and there is scarcely a mark of wear on any of them. You will find occasionally a bright spot where the box was not quite straight, perhaps, but there is no destructive wear on the material. I saw, just before I came away from Nicetown, a shaft about 8 feet long, I should judge, loaded with 5,000 pounds of castings; the bearings were $9\frac{1}{2}''$ long by $2\frac{7}{16}''$ diameter—simply a pair of hangers reversed; and the cast-iron box, supported by two screws, which would necessarily, with the weight on them, make the box pinch—and it did pinch pretty hard when the box first started, so that the shaft was sufficiently hot to melt an excellent quality of babbitt metal at the rate of about $\frac{1}{4}''$ in 10 seconds; it would melt it right off, making a continuous stream of babbitt metal running from the piece that was held against it. After running that thing ten days, at 300 revolutions per minute, there was no appreciable wear on the box other than that it relieved itself from this pinching; the shaft was covered by a thin coating of graphite, and my friend, Mr. Cooper, assured me that he had never seen the slightest mark of abrasion on any shaft, and he had been testing it for about eighteen months. This shaft ran cool enough so that you could bear your hand on it, and after two days' of such running I saw the boxes taken out, and there was no appreciable wear.

Mr. Dickie inquired as to the use of the material for the bearings of engines, and in replying, Mr. Trump said: "At 123 North Fifth street, Philadelphia, they had an engine of about twenty horse power fitted all

through with bearings of this material. They also had a dynamo fitted throughout running five arc lights, the shafting, as I said before, being also fitted with it. It had been running since last June, in Philadelphia, from eight to ten hours a day, and it had been previously used in Gardiner, Me., where the inventor lived for some six or eight months.

The superintendent of the Market street traction road, in Philadelphia, put in some twenty four of these bearings for grooved pulleys carrying the cable—two at the crown where the cable came from the driving plant up into the street—a very difficult place for anything to stand. They had had a great deal of difficulty with those bearings. The fiber graphite bearings had been run for some six months, when the superintendent gave a certificate that they required no attention. The others used on those grooved pulley bearings were in places where they were covered with water running in from the street into the trunk carrying the cable, and he states that they had not required any extra attention, and were apparently in as good order as when put in.

Mr. Cummings stated that he had had a pulley bushed with graphite which was put into a brass sleeve in sticks about the size of a pencil. It ran well for three years, and then gave out all at once. He had been informed by Mr. Stevens, of Sacramento, the superintending engineer of the railroad there, that they had tried it in a connecting rod, but it was pounded out. Other cases were referred to where bearings composed partly of graphite had run well for a time, and then given out all at once and completely, but there was none of them constructed like those under discussion. Referring to its use for dynamo brushes, Mr. Trump said he saw on the dynamo of which he had spoken, a pencil of this material, ¼″ square, which was carrying the whole current for the five arc lights, and there was not a particle of roughness on the commutator, and only a very little wear on the pencil—scarcely appreciable, so that the brush required but little adjustment. Mr. Keith said that is certainly better than a copper bearing; the best available conductor carrying, I presume, ten amperes of current from the commutator; a copper brush would have to have a greater bearing than $\frac{1}{16}$ of a square inch, which would be the bearing from a brush ¼″ square.

Mr. Spiers thought that what was desired was a series of experiments under varying and known pressures per square inch.

Mr. Trump: I had from Mr. Cooper since I last saw him a letter in which he says: A tubular box in which a shaft ran 3,300 revolutions for five months, ten hours per day, showed wear upon a few spots only, which were as bright and smooth as glass. The bearing had not been machined at all, but was as it came from the mold, and the circular part of it was not true as it would have been if we had bored it. The shaft simply touched in spots, and those spots were bright.

Another sample that I saw at Nicetown was of a shaft carrying a 500-pound weight, the two journals ⅞″ in diameter and about 3″ long, that had been running at from 2,500 to 3,500 revolutions, for something like fifteen months, eight to ten hours a day. I saw those boxes taken out, and, as we would express it in ordinarily fitted up machinery, the shaft had not come to a bearing yet.

Some time since we noted the fact that the Standard Oil Company had dissolved as a trust. There was in many quarters considerable rejoicing over the fact, but we pointed out that the real effect upon the business of the company and upon its method of doing business would probably be scarcely noticeable. As an illustration of this fact it is announced that what has been known as the New Jersey Oil Company of Newark has been "absorbed" by the Standard, the dispatch announcing the fact reading for all the world just as similar dispatches used to before the Standard trust dissolved.

A special train of four cars over the Pennsylvania Railroad was recently run between Philadelphia and Washington, 140 miles, in 150 minutes.

A New Thirteen-Inch Engine Lathe.

During the past two years or more, visitors to the shops of the Brown & Sharpe Mfg. Co., at Providence, R. I., have noticed lathes in use about the shops that differed from the ordinary construction so much as to attract attention. At first, and for some time, there was but one of these, and that was used on the "tool job." Not much was said about it, except that it represented some ideas that they were testing, but a lathe subsequently built, in which some modifications were introduced, was more freely discussed, after which a lot of them were made and tested in this and in other shops, pains being taken to test them on work of varying character, including general machine work, electrical instruments, dies, bolts, bicycles, tools for watch making, and small parts of harvesting machines. Opinions and criticisms were invited, and in the building of the next lot of twenty lathes all these were considered; and in the light of the experience thus gathered, in addition to their own, the manufacturers are now regularly building the lathes, as shown by the accompanying drawings, in large lots.

As will be seen, the bed is mounted upon short legs which stand within a tank table adapted to catch and hold oil, water and chips, as in the case of screw machines, a well being also provided, from which oil or water

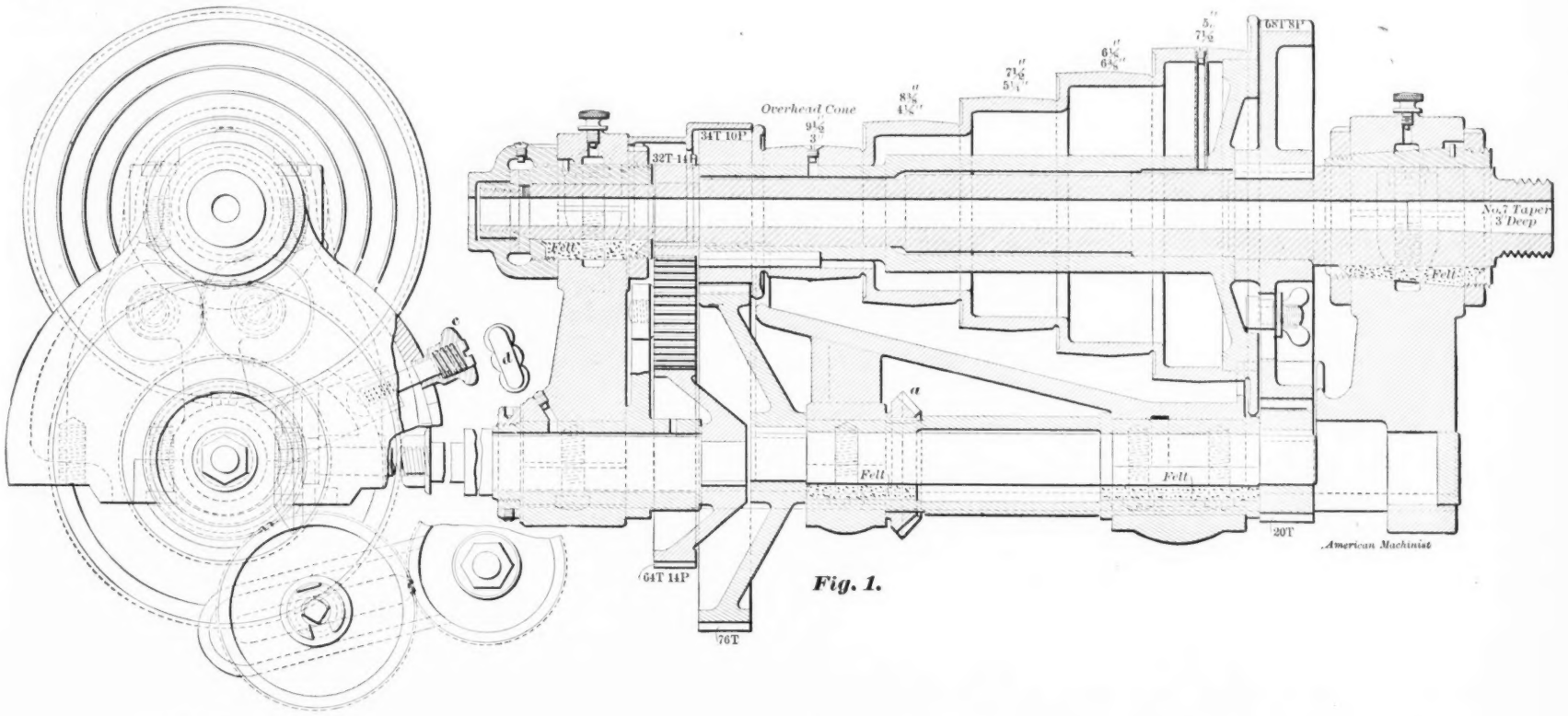


Fig. 1.

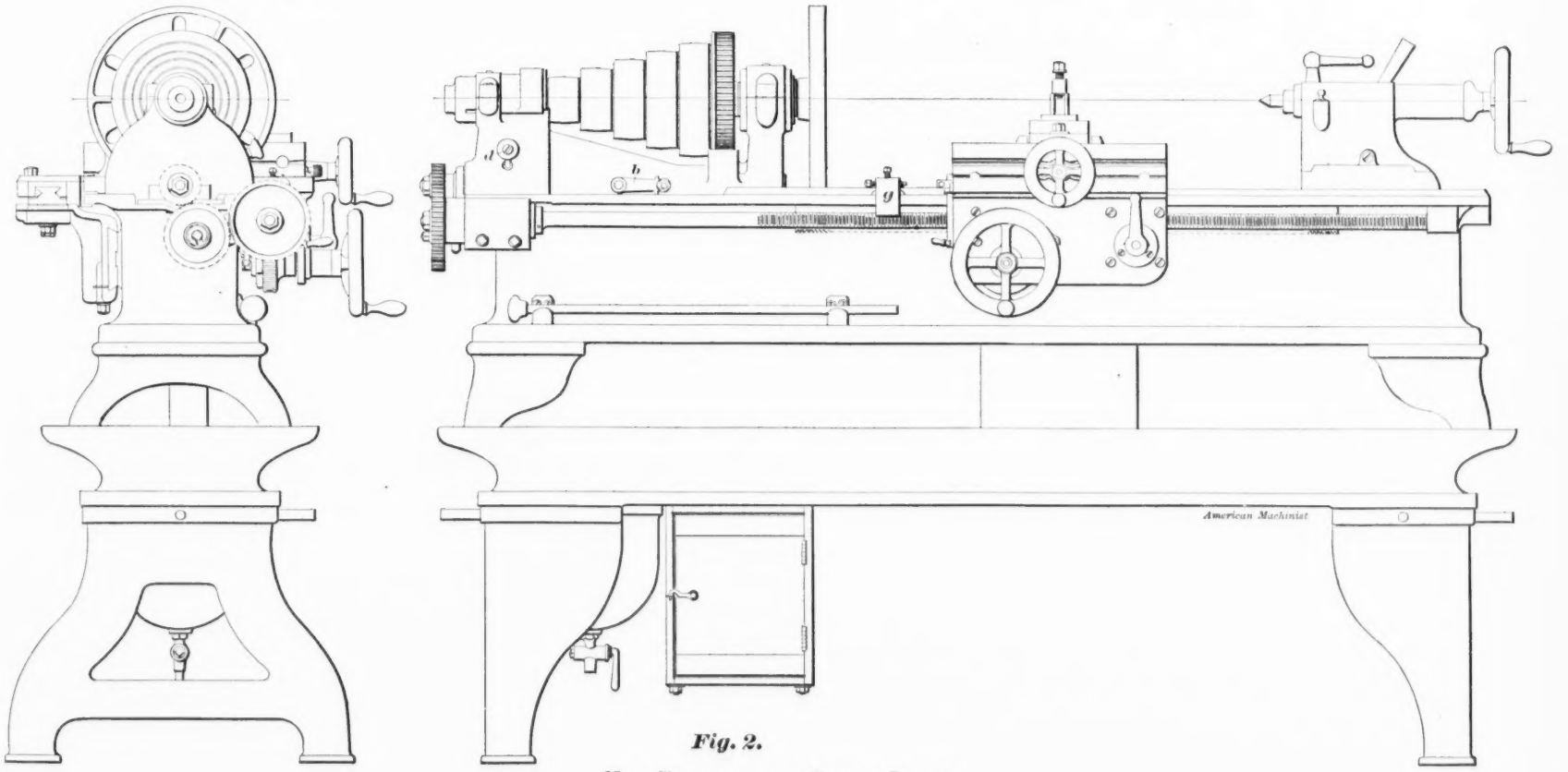


Fig. 2.

NEW THIRTEEN-INCH ENGINE LATHE.

can be drawn off. Below the table is a partitioned box for the reception of the change gears.

Referring to Fig. 1, which is a longitudinal section and end view of the head stock, it is seen that this is very substantially proportioned and rests upon broad flat surfaces at the top of the bed. The spindle is of steel, hardened, ground and lapped to fit the boxes, which are also of hardened steel ground and lapped, and with provision for adjustment by means of the threaded rings at either end. Strips of felt are introduced below, to which the oil passes through the annular channels seen passing around the boxes from the oil holes at the top, this arrangement insuring efficient lubrication. End thrust is taken at the rear end and on collars which are hardened and ground.

The cone pulley has five steps for a 2″ belt, and the back gears are proportioned 7.6 to 1. The location and arrangement of the back gears differ essentially from the ordinary lathe, as will be seen. Placed underneath the cone pulley, where they are effectually protected from dirt, dust, and accidental injury, the quill is supported in boxes attached to the web, and is revolved to throw the gears into and out of contact by means of the bevel gear *a*, which engages with a similar gear which is on a shaft, at the other end of this shaft being the crank lever *b*, Fig. 2, which is provided with projecting lugs that rest upon the bed, and thus define the proper positions of the gears without further attention. The pinion at the end of the cone and that on the spindle for driving the feed gears are entirely covered up and protected, the whole arrangement being exceedingly neat, cleanly and convenient.

The motion of the feeds is reversed by the usual swinging plate the position of which is fixed by the sliding knob *e*, Fig. 1, the hub of this knob fitting into the three counterbores formed about the slot through which the lever works, as shown at *d*.

The change gears are arranged in the usual manner, except that the intermediate stud is made sufficiently long to admit a collar beside the gear, which, when replaced by a second gear, and the wheel on the screw shifted, as provision is made for doing, the lathe is compound geared, the simple gearing providing, however, for all threads from 3 to 16 per inch, and nearly all from 16 to 48 per inch. End thrust of the screw is taken in either direction by the box at the head of the lathe, leaving the screw free to expand or contract by differences of temperature.

The screw is splined, and fitted to it is a worm from which the feed is derived in the manner shown by the drawings, this part of the mechanism including a friction clutch in which the ordinary beveled friction surfaces have been discarded and cylindrical surfaces with expanding sections of rings substituted, these rings being expanded to throw in the feed by means of the bell crank levers *e e*, Fig. 3, which are moved by means of the plunger pin seen between them, this pin being itself moved by the lever *f*. The plunger pin is provided at the end with a screw upon which the lever *f* rests, this screw, with its check nut, serving as a means by which the clutch is adjusted. The lever *f* is attached to a shaft, at the other end of which is a small hand-lever by which the feed is thrown in or out, arrangement being also made for releasing the feed automatically at any desired point by the stop *g*, Fig. 2, which can be clamped to the bed. The spiral spring at the right of the plunger bolt actually releases the feed when the lever is released, and at the same time keeps all joints and working points in the device in snug contact at all times.

The carriage, as will be perceived, is both gibbed and weighted, the weight keeping both the cross-feed and carriage to a proper bearing under ordinary circumstances, while the gib at the back prevents the carriage from raising in case there is a tendency to do so. It will be noticed also that the carriage rests upon a large V in front, and upon a flat surface at the rear, the advantages of this arrangement having been previously discussed in our columns, notably by Professor John E. Sweet, within a short time.

The cross-feed screw is journaled in a bearing which is attached to a bar passing to the back of the carriage, and which can be attached to the taper attachment block in the manner shown at the extreme left of Fig. 2. Two stop screws are permanently attached to the carriage, one for inside and the other for outside screws.

The foot-stock rests upon the flat surfaces at the top of the bed, and is secured by the movement of a lever which works an eccentric. The hub of the hand-wheel here is graduated in .01″, that on the cross feed screw in 64ths, and for the carriage feed in 32ds.

The drawings show clearly the substantial proportions of the lathe which swings over the bed 13′, over the carriage 5½″, and will take between centers 33″.

The taper attachment is graduated in both taper to the foot and in degrees; 2″ to the foot or 4° of taper being provided for.

The intention has been to provide a substantial, stiff and slow wearing lathe adapted to the best work, and also by its liberal bearing and wearing surfaces to the heaviest work usually done upon lathes of this size. The lathe weighs 1,650 pounds, and occupies a floor space 24″x70″.

As to the accuracy with which the lathe is constructed, we cannot do better than to state the inspection limits; the inspectors in the B. & S. shops being responsible only to the superintendent, and entirely independent of the foreman of the department where the machines are built. In determining that the center hole in the live spindle runs true, an arbor fitted to this hole is placed within it, and must not vary more than .0005″ at the end of the spindle, nor more than .002″ at a point 12″ from it. Using an arbor as before, the spindle must be found to line with the ways vertically within .001″ in 12″, and within .0005′ in 12″ in a horizontal plane, the latter variation being confined to the rear of the true center line, and no variation whatever being allowed in the other direction. The foot-stock spindle must in any position be within .001″ of the same height as the live spindle. As these figures represent the extreme allowable variations, it will of course be understood that in most cases the variation is materially less, and in some cases a very near approach to actual perfection is attained. In a recent lot of twenty-five lathes the extreme variation found in the lead-screws was .0037″ short in 24″, while the variation from standard was in some cases as low as .0002″ in 6″. Each lathe is operated by the inspector, and in squaring up a plate 12″ diameter screwed on the end of spindle, it must not show a variation from a true plane exceeding .001″, while the limit in boring is .001″ large at the front end in 12″.

This making public the inspection limits of certain machines made by the Brown & Sharpe Company has been for some time in contemplation by them, and as a matter of course we are glad to give them, for such a practice is in accordance with our ideas on this subject, expressed before we knew that any manufacturing firm had such a step under consideration.

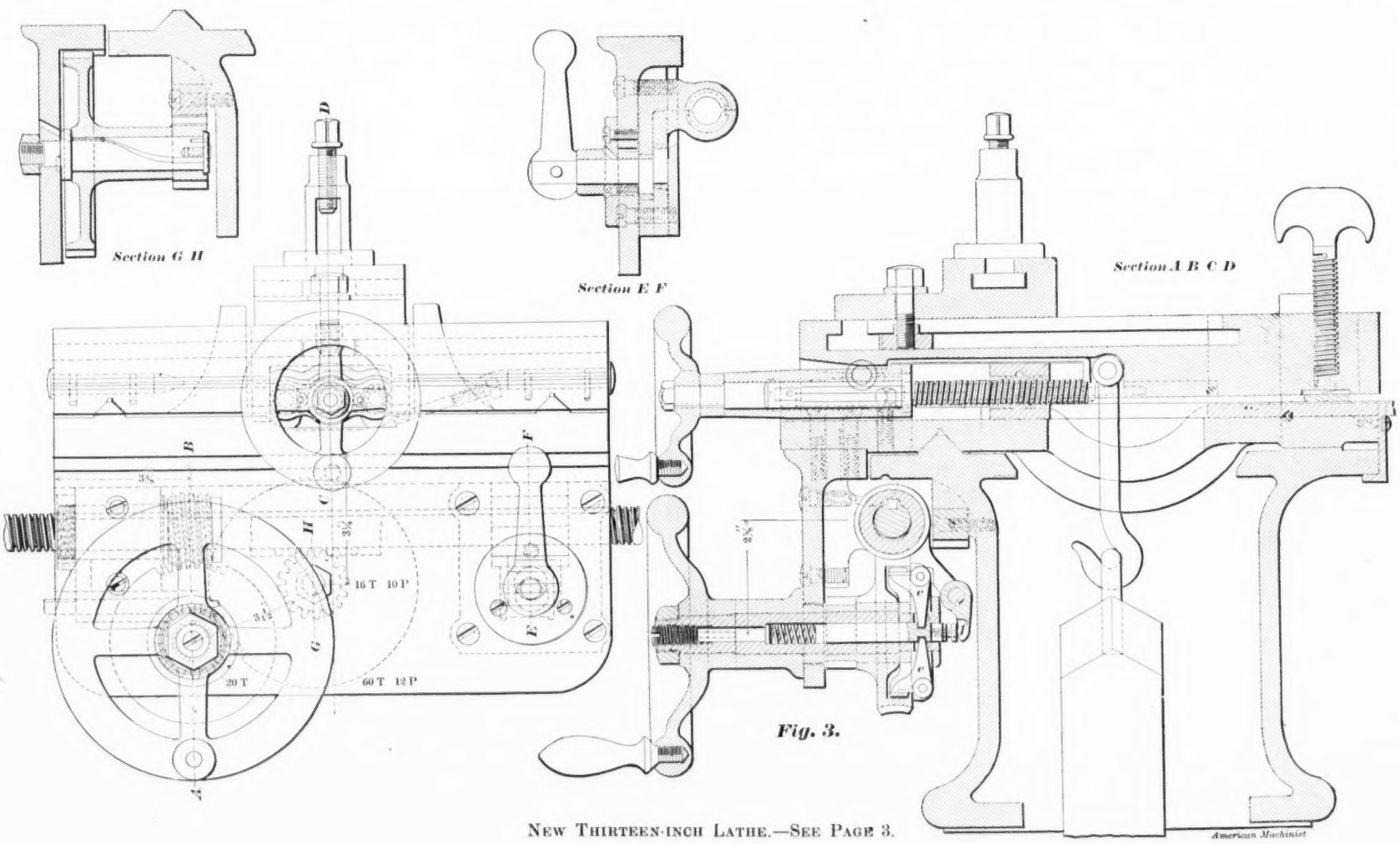


Fig. 3.

NEW THIRTEEN-INCH LATHE.—SEE PAGE 3.

The Size of a Ball.

In our issue of July 14, we answered a question regarding the comparative size of balls, which answer has brought us several letters, the writers of which seem to think that our answer was wrong. The question was, "How much larger is a 2″ than a 1″ ball?" and we answered, "Twice as large." Now our correspondents besiege us with rules and formulas, etc., all proving that the surface of the ball is πd^2, and that its contents are $\frac{\pi}{6} d^3$, and asking us how we arrived at our conclusion. Our answer to this is that we arrived at our conclusion by giving a direct answer to the question asked, which was not how much greater in area nor how much greater in solid contents or weight, but *how much larger;* and in ordinary every-day language, if we ask how large a ball is, we mean to ask what its diameter is, not its superficial area nor its solid contents. In other words, when we speak of the size of a ball we always refer to its diameter, unless otherwise specified, and where diameters are in question a 2″ ball is twice as large as a 1″ ball. Our answer was given deliberately, and we believe is right.

Why do not girls who spend their time sighing for a career learn their father's business? A man died in this city a few years ago, leaving a manufacturing business that paid $6,000 a year, but not one of his large family of daughters was able to conduct it, and therefore it passed to strangers, while the family went into comparative poverty. When a real estate man died in Jersey City not long ago his daughter announced her intention of carrying on the business; she had assisted her invalid father in his office and had become so familiar with the business that she is now conducting it successfully.—*Newark Advertiser.*

The New York Central & Hudson River Railroad Company has bought the Adirondack & St. Lawrence Railroad. This practically gives the New York Central a through line of its own into Montreal.

The recently circulated report that the World's Fair at Chicago was bankrupt is officially denied, and the statement made that plenty of money is on hand to meet all demands.

Graphical Construction of Indicator Diagrams of Multi-Cylinder Engines.

BY E. THEISS.

The use of theoretical indicator diagrams for examining into the distribution of steam throughout the cylinders of multi-cylinder engines, while of unquestionable interest to the student, is well worth the serious consideration of the practical engineer. For example, the relative sizes of the cylinders of a triple-expansion engine having been decided upon, it becomes a question so to adjust the cut-off in the high-pressure cylinder as either to equalize the range of temperature in the cylinders or the work performed by each. An expeditious, graphical method of constructing the diagrams would make this determination an easy one.

For the following we are indebted to contributions on this subject that have appeared in the *Zeitschrift des Vereines Deutscher Ingenieure* by E. Mönch and Moritz Kohn. Rankine's method of combining indicator cards has been adopted. In accordance with this method pressures and volumes are represented on the same scale for all the cylinders, and the diagrams plotted on a system of rectangular co-ordinates.

The details of construction will be explained by application to the diagrams of a continuous expansion compound engine, and one with cranks at right angles, after which their application to multi-cylinder engines with any crank arrangement possesses no further difficulties. In the continuous expansion compound engine there is a fixed relation at all points between the volumes swept out by the pistons of the two cylinders, while in engines with angles between cranks anything between 0 and 180° the use of an auxiliary diagram for determining the volumes at any point is required.

I. *Continuous expansion compound engine.*

To construct the diagram let the following data be given:

Initial pressure $= p_1 = 105$ lbs.

Back pressure $= p_2 = 3$ lbs.

Ratio of volumes of cylinders $= m = \frac{A_2\ s_2}{A_1\ s_1} = 2.3$, where A_1 and A_2 and s_1 and s_2 are the piston areas and strokes of the high and low-pressure cylinders respectively.

Ratio of volume of receiver to stroke displacement of the H. P. cylinder $= p = \frac{Vol.\ Rec.}{A_1\ s_1} = 2.3$.

Volume of clearance of the H. P. cylinder $= c_1\ A_1\ s_1$, where $c_1 = .05$.

Volume of clearance of the H. P. cylinder $= c_2\ A_2\ s_2$, where $c_2 = .04$.

The diagram, Fig. 1, is constructed for a cut-off in the H. P. cylinder of 0.4. To the right of a point O on a horizontal line the volumes of the cylinders and their clearances are plotted to any convenient scale. The scale of pressures is preferably selected so as to make the ordinate representing the highest pressure equal to the length of the diagram. The curves of expansion have been taken to be rectangular hyberbolas throughout; they are readily constructed, and show a close agreement with actual expansion lines. The construction is shown in Fig. 2. The pressure $p_1 = V_1\ P_1$ for a certain volume $v_1 = O\ V_1$ being given, that corresponding to a volume $v_2 = O\ V_2$ is found by erecting a perpendicular at V_2 and making $V_2\ P'_1 = V_1\ P_1$. Draw $O\ P_1$, connecting P'_1 with the origin. The intercept $V_1\ P'_2$ on $V_1\ P_1$ will give the pressure at V_2, and P'_2 projected upon $V_2\ P'_1$ will give P_2 as a point on the curve. In proof we have the proposition:

Fig. 2.

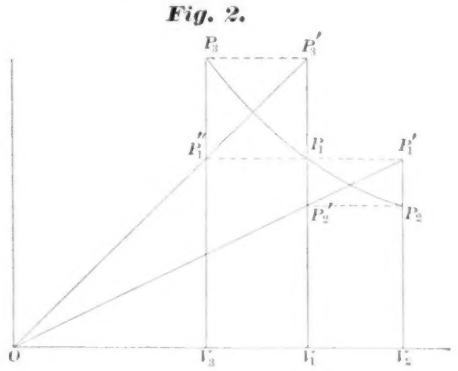


Fig. 3.

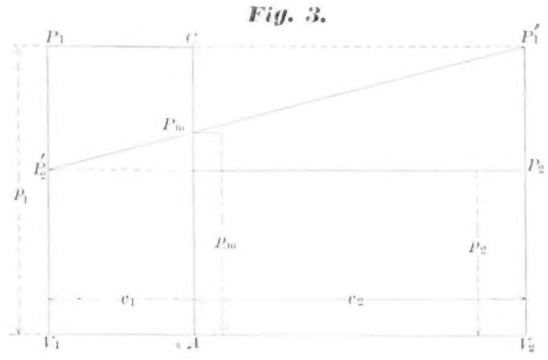


Fig. 4.

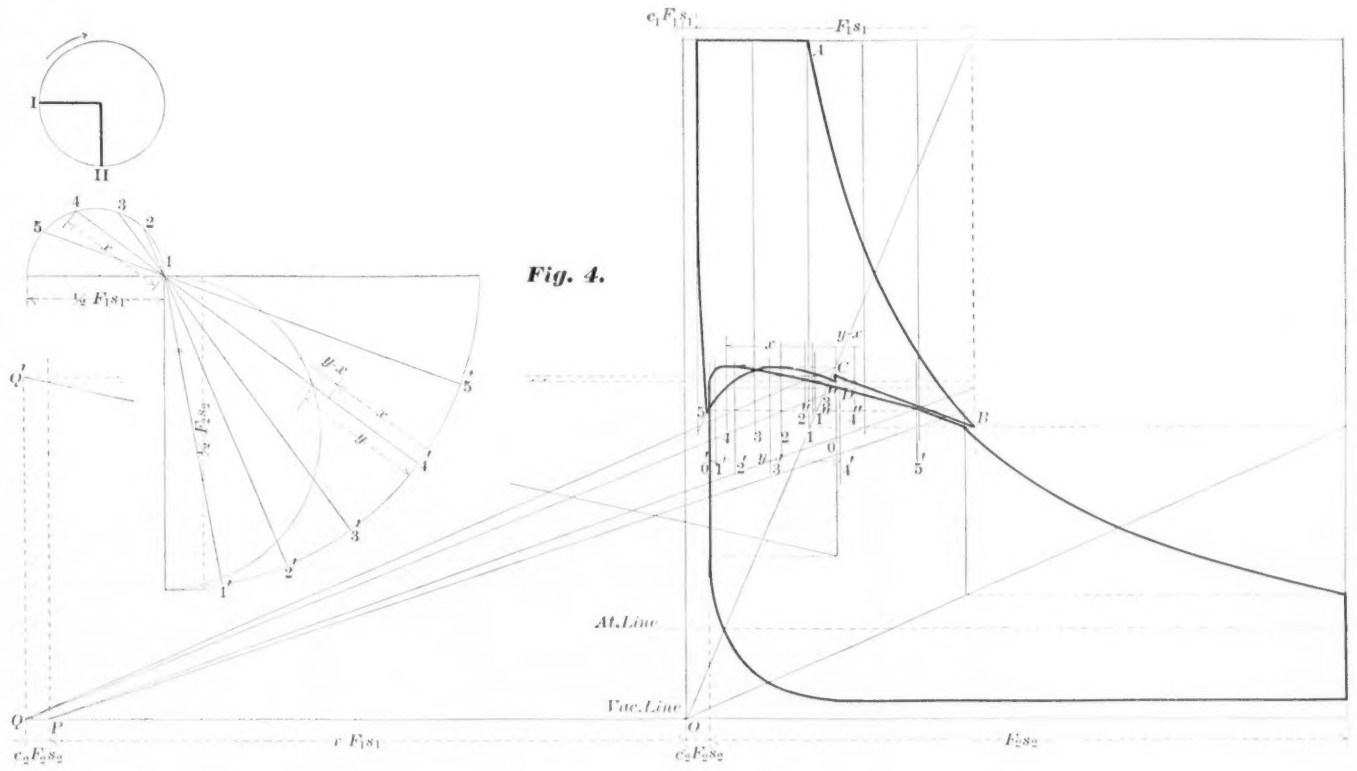
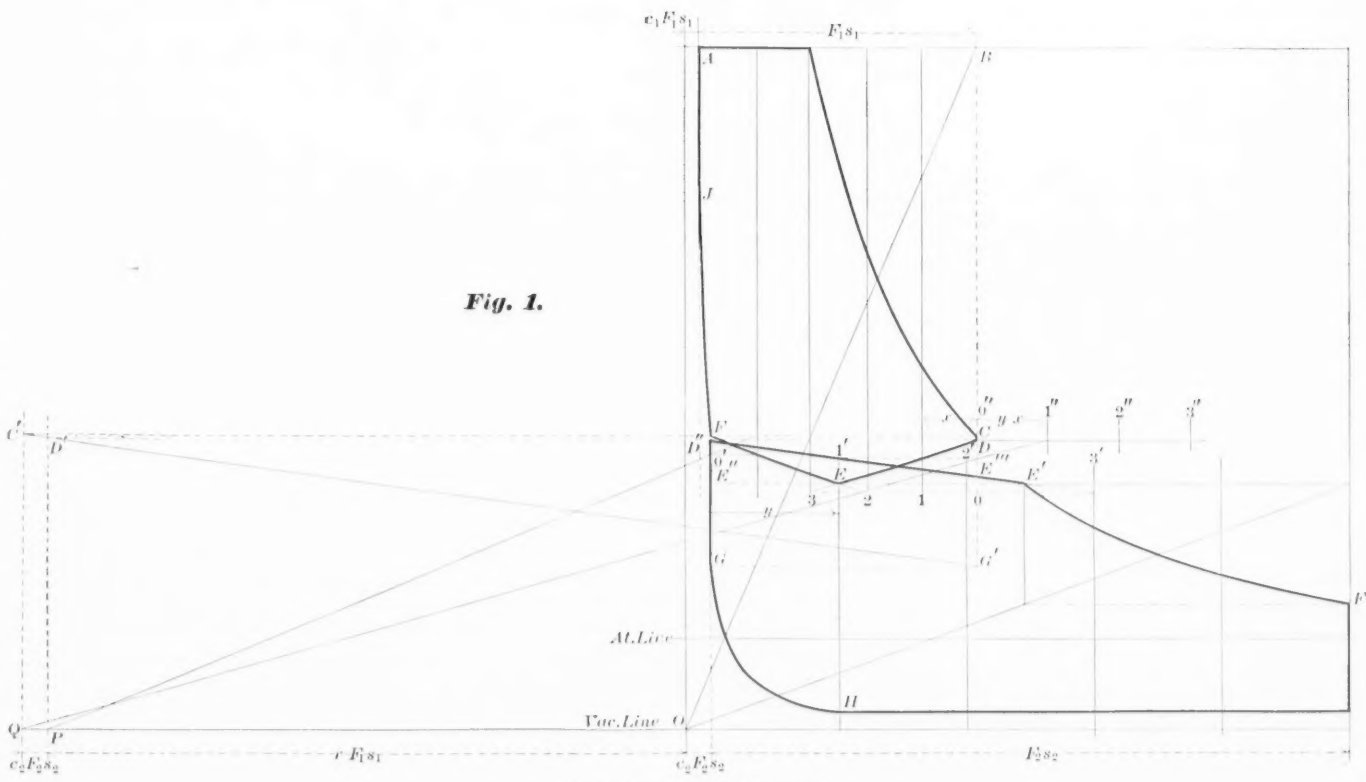


Fig. 1.



MULTI-CYLINDER ENGINES.

The pressure $p_1 = V_1\ P_1$ for a certain volume $v_1 = O\ V_1$ being given, that corresponding to a volume $v_2 = O\ V_2$ is found by erecting a perpendicular at V_2 and making $V_2\ P'_1 = V_1\ P_1$. Draw $O\ P_1$, connecting P'_1 with the origin. The intercept $V_1\ P'_2$ on $V_1\ P_1$ will give the pressure at V_2, and P'_2 projected upon $V_2\ P'_1$ will give P_2 as a point on the curve. In proof we have the proposition:

$O\ V_1 : O\ V_2 = P'_2\ V_1 : P'_1\ V_2 = P_2\ V_2 : P_1\ V_1$. In compressing to a volume $V_3 = O\ V_3$, the pressure $p_3 = P'_3\ V_1$ is found in the same way.

This method of construction may now be used for plotting the expansion line following upon the admission line $A\ B$, $A\ B$ being the volume at cut off, $O\ A$ the initial pressure. The construction lines are given only for the terminal point C. For the present, to simplify matters, it is assumed that expansion takes place to the end of the stroke, there being no exhaust lead.

The pistons of both cylinders have now reached the end of their stroke, and the H. P. cylinder is placed in communication with the receiver and the clearance space of the L. P. cylinder, which latter now begins to take steam. There will be a sudden drop of pressure if that existing in one or the other of these spaces is less than the terminal pressure in the H. P. cylinder. The pressure in the L. P. clearance space will, in general, be lower, as it is practically impossible to compress from the pressure of the condenser to the initial pressure. In the receiver this pressure may in all cases be reached by proper adjustment of the cut-off in the L. P. cylinder. Such is assumed to be the case in the present problem. The fall of pressure will therefore be due entirely to the lower pressure existing in the L. P. clearance space. The resulting pressure, p_m, is determined accurately enough for practical purposes from the formula $p_1\ v_1 + p_2\ v_2 = p_m(v_1 + v_2)$ where v_1 and v_2 are the volumes put in communication, and p_1 and p_2 the corresponding pressures before mixtures. Graphically the solution proceeds as shown in Fig. 3. To the right and left of any point A on the horizontal line $V_1\ A\ V_2$ lay off $A\ V_2$, and $A\ V_1$, representing volumes v_2 and v_1. Let p_1 and p_2 be the pressures belonging to v_1 and v. Then on a perpendicular at V_1 lay off $V_1\ P'_2 = p_2$; and on a perpendicular at V_2 lay off $V_2\ P'_1 = p_1$. Connect $P'_1\ P'_2$; the intersection of this line with a perpendicular at A will determine a length $A\ P_m = p_m$, the mean pressure desired. In proof we have $P_m\ C : P_1\ P'_2 = C\ P'_1 : P_1\ P'_1$ or $(p_1 - p_m) : (p_1 - p_2) = v_2 : (v_1 + v_2)$; hence $p_m(v_1 + v_2) = p_1\ v_1 + p_2\ v_2$.

Proceeding with the construction of the diagram, lay off to the left of O a distance $O\ P$ representing the volume of the receiver, and $P\ Q$ representing the L P clearance volume. Let the final pressure of compression in the L. P. cylinder be such as would be given by closing the exhaust when the piston had completed .8 of its stroke. The equation of the compression curves has been taken $p\ v^{1.2} =$ construction throughout as giving close agreement with actual curves. Let G mark the end of the compression curve; then, using the construction

explained above, the intersection of the line connecting points C_1 and G_1 with the perpendicular at P will give D_1 P, the pressure after mixture. This projected upon the proper ordinate gives point D of the diagram. At this point expansion begins in both cylinders and in the receiver, and the expansion line marks the lower limit of the H. P. diagram. Losses of pressure being disregarded, the same line will mark the upper limit of the L. P. diagram. These curves may be drawn as follows: Divide the volume of the H. P. cylinder into any number of equal parts x, and the L. P. volume into the same number of equal parts y. Numbering these divisions consecutively from D and D', similarly numbered divisions will give corresponding piston positions for the two cylinders. For a movement of the pistons through one division the aggregate volume will therefore be increased an amount equal to $y - x$. Lay off divisions equal to $y - x$ to the right of D, numbering them 1″, 2″, 3″, etc.; connect these points with Q; then these radial lines will intercept on the ordinate through D lengths giving the pressures. To draw the curves it then remains to project these lengths upon the proper ordinates in the diagrams.

The cut-off in the L. P. cylinder is so adjusted that after it has taken place the steam in the H. P. cylinder and the receiver will be compressed to the terminal pressure at C. The H. P. exhaust is now closed, and further compression takes place in the cylinder alone.

As the point at which the L. P. cut-off is to take place is as yet unknown, we must reverse the process of construction, beginning with point J, which marks the final pressure of compression in the H. P. cylinder. Through the point so fixed pass the curve given by the equation $p\, v^{1.2} =$ construction. To be able to plot it quickly it is advisable to work out for the equation $p = \left(\frac{v_0}{v}\right)^{1.2} p_0 = k\, p_0$ values of k for a series of values of the ratio $\frac{v_0}{v}$. To find the pressure at any point, all we have to do then is to multiply the final pressure by the appropriate constant.

For $\frac{v}{v_0}$ =	1.5	2	2.5	3	3.5	4
	5	6	8	10		
k =	0.61	0.43	0.33	0.27	0.22	0.19
	0.14	0.12	0.082	0.063.		

Compression begins in the H. P. cylinder when the pressure in the receiver has risen to the pressure existing at C. The compression line is therefore to be continued until it intersects a horizontal line through C in point F. This latter point fixes the pressure and volume at the end of the period of compression in the H. P. cylinder and receiver. The corresponding curve is readily drawn, being a rectangular hyperbola with origin at P. The point of intersection E of this curve with the expansion line previously drawn fixes the position of the H. P. piston at which cut-off must take place in the L. P. cylinder. The projection of E upon curve D' E' fixes the position of the L. P. piston. As a check, E E' + E E''' = m. The L. P. diagram is completed by drawing the line of expansion through E', which is a rectangular hyperbola with origin at O.

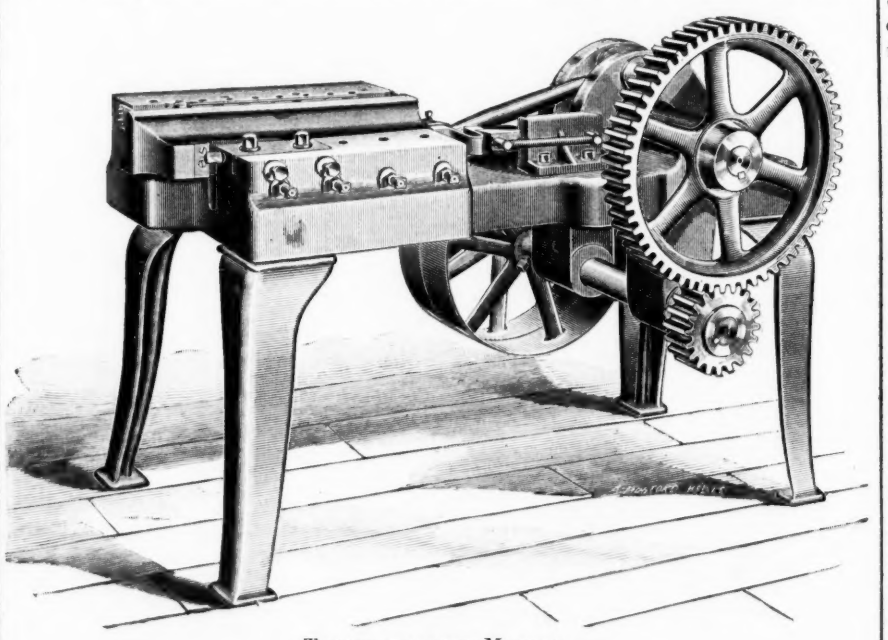
II. *Compound engine with cranks at angles other than* 0 *or* 180°.

In Fig. 4 the diagram is drawn for an engine with cranks at 90°. The volumes and pressures are as in the preceding problem. For the determination of the piston displacements at any point recourse is had to an auxiliary diagram, obtained as follows:

In Fig. 5 let A O and B O be the initial positions of the cranks, the angle between them being a. Let A O and B O represent on the same scale the half volumes of the two cylinders; then for this, as for any other position of the cranks, as when turned through an angle b, the projection of A and B upon the straight line through the turning point O will give volumes swept out by the pistons measuring from mid-stroke. A_1 O and B_1 O and A_2 O and B_2 O are corresponding volumes found in this way. The result may be obtained by keeping the cranks fixed and revolving the line P P in a sense opposite to the motion of the cranks, Fig. 6. It is evident that the locus of points A_1 and B_1 will be circles described on the cranks as diameters. The chords intercepted upon any line drawn through O will then give the volumes. If the crank circles are drawn then the intercepts a_1 and b_1 and a_2 and b_2 will give volumes measured from the end of the stroke. By the aid of a similar auxiliary diagram shown in Fig. 4 the curves of the indicator diagrams may now be drawn.

The L. P. piston (Fig. 4) being at the beginning of its stroke is ready to take steam. The H. P. piston is then at mid-stroke at C. Between B and C the L. P. cylinder is not in communication with the receiver, and compression takes place in the latter and in the H. P. cylinder. No drop of pressure occurs at B, as the L. P. cut-off is assumed to be adjusted to bring the receiver pressure up to the terminal pressure in the H. P. cylinder. Curve B C is drawn with origin at P. At C communication is established with the L. P. clearance space, and the drop is found as before, D marking the extremity of the pressure ordinate so determined. After this the movement of the pistons brings about first compression and then expansion. Suppose that the volume C Q_1 at C has been diminished by the movement of the H. P. piston an amount represented by x; then from the auxiliary diagram we find that during the same time the movement of the L. P. piston has brought about an increase represented by y. The change of volumes will therefore be represented by $y - x$, a positive value of this difference meaning expansion, a negative one compression. If now this difference is laid off on the horizontal line through D to the right if expansion, and to the left if compression takes place, and the terminal point is connected with Q, then the pressure is given by the intercept on the ordinate at D. The projection of the point determined upon the proper ordinates of the diagram fixes points upon the curves.

In the figure, positions of the H. P. piston are taken at equidistant intervals and are figured 1, 2, etc.; corresponding points for the L. P. piston are figured 1′, 2′, etc., and the ordinates giving the actual aggregate volumes, 1″, 2″, etc. It is to be remarked that in the crank diagram the crank positions corresponding with the piston positions plotted in the indicated diagram are figured in the inverse order, the reason being found in the nature of the diagram as explained above. The curve just constructed is continued for the H. P. cylinder to its intersection with the compression line previously drawn. For the L. P. cylinder this point is found by projection upon the expansion line continued, or more accurately by determining the piston position from the crank diagram. At this point expansion begins in the receiver and L. P. cylinder alone, and the curve is a rectangular hyperbola constructed from the origin P. It is continued to its intersection with a horizontal line through B, *i. e.*, until the receiver pressure has fallen to the terminal pressure in the H. P. cylinder. At this point steam is cut off in the L. P. cylinder, and expansion takes place in the cylinder alone. The rest of the problem presents no difficulties.



THREAD-ROLLING MACHINE.

Thread-rolling Machine.

July 28, we illustrated and described a machine for rolling or cold-swaging threads on the spokes of bicycles or for similar work, and specified some of the advantages peculiar to this method of threading small rods. The present machine, made by the same company, is intended for larger work—from $\frac{3}{16}$″ to $\frac{7}{16}$″—and will roll threads of any length up to $1\frac{1}{2}$″ on either steel or brass. Such threads can be rolled at the rate of 50 pieces per minute, or as fast as they can be handled. The dies are readily changed from one job to another, and where fine threads are required diameters up to $\frac{9}{16}$″ can be rolled. Dies can also be used for making taper or gimlet pointed screws if desired. Accurate sizes, smooth threads and good work generally can readily be secured by this process. This machine weighs 1,900 pounds, and is made by Blake & Johnson, Waterbury, Conn.

LETTERS FROM PRACTICAL MEN.

American versus German Machinery.

Editor American Machinist:

When I wrote concerning certain German machinery I was not doing so in order to puff this up, but simply to note facts which had come under my notice, and so was a little surprised at the letter of Anti-brag which followed it, especially as he professes to know the firm to whom I referred, though he shows his real ignorance of them when he refers to the American engineer as a native of Athol. The American engineer of whom I wrote is not a native of Athol, so this fixes the matter and I need say nothing further. As regards the exact reproduction of American tools by Germans, though in this particular case Anti-brag happens to be wrong, I do not know that the exact reproduction of a good machine in good material, however it may clash with our sense of commercial morality, will prevent such exact copy from being sold, and, if Germans will copy, is it not better that they should make good copies than colorable out-of-truth imitations, at a price with which a good tool cannot compete? Patriotism has so many significations now-a-days that it is difficult to follow Anti-brag in his remarks as to the want of it. There are some who would doubt even the patriotism of Anti-brag himself, who, as an American, is endeavoring to shower upon the British Isles the advantages of American productions, whilst a very small party in this country, headed by a certain highly placed marquis, would abandon our present free trade principles and shut out both German products and those which Anti-brag would sell. But, though they pose as patriots, their real object is to, nominally, make farming more profitable—actually to enable farmers to make an extra dollar, so that an extra two dollars of rent may be squeezed out of them.

Now we have a way in England of buying anything that may suit us best, and we do not inquire specially into its antecedents, and I think your correspondent is a little out when he says we are likely to prefer the genuine article to a German imitation, however good. If the German imitation be as good or true at equal price it is just as certain to be bought. The English producer himself would look for no favor as against as good an article of foreign make, and the buyer would allow him none, patriotism or no patriotism; and why should one importer be favored above another? Their respective countries both treat us about equally bad in regard to tariffs. If Anti-brag wishes to create a diversion in favor of American as against German tools, he can point a way, being an American, which is not open to me to do.

As regards copying, where are we to draw the line. Are not ideas copyable?

When the locomotive was invented by an Englishman, Americans speedily adopted the idea; was this to be condemned, and should Englishmen avoid twist drills? I believe these were invented in America.

Now one may copy a design throughout and utterly fail to produce a machine which will do *like work*, and that is the real test of a copy. Here we should only be too pleased if all Germans would copy and go to the full extent in doing so—copy good workmanship—for if they did so they could not possibly sell this at tin pot prices, and the whole trade morale of Germany would be raised, and there would be less German cast iron up and down the world with "Sheffield" marked on it than there has been and still is.

It is not of reproduction that manufacturers need to be so much afraid as of inferior imitations not to be discerned by the untutored eye, and it is to be remembered that there are thousands of men who have occasion we will say to use a lathe, and who will wish to have the tool good, and yet who are unable to discern wherein a poor imitation in workmanship is really inferior. They see the two articles alike, just as your readers would, many of them, be unable to distinguish a good or a poor animal on a farm. Then again, as we all know, it is not always the most competent man who is intrusted with the purchase of tools, and the apparent copy has as much value in his eye as the good article.

Now would it not be just as well if Anti-brag would recognize, even on his own admission, that German tool makers, only lately any thing accounted of, who have so far stepped to the front as to have even come into the limits of a dispute, will probably not stand still even at that? Till lately there has not even been a question of their inferior workmanship, and if they choose to put good work into even pirated designs the fact has got to be faced by English and Americans. They may not be able to compete against American productions in America, but they will be able to do so in all countries where the products of both are subject to equal tariffs, or, as here, to none. Is not this—like his rentals at the back of our Premier's newly developed craze—somewhere at the back of Anti-brag's new version of his compatriots' patriotism?

W. H. BOOTH.

English as She is Spoke.

Editor American Machinist:

The English-American language is growing at such a rate that a new dictionary should be written every year to keep up with it. The prevailing tendency is to substitute an adjective for a noun or for the combination of a noun and an adjective. An example is seen in the AMERICAN MACHINIST of July 21st. "Suburban electrics come right into the crowded part of the city." The following are a few definitions showing recent usage:

Electric—A street railway car propelled by electricity.

Trolley—An "electric" that receives its electricity through a trolley.

Elevated—A passenger car run on an elevated railroad.

The corruption of the language which these examples indicate is not confined to America. It is even worse in England, thus:

American Rails—Shares in American railroad companies.

"Passengers are found in a liberal table"—(Advertisement of an English steamship line). The definition of the words "found," "in," "liberal" and "table" in this sentence would defy a lexicographer. CRITIC.

Marking of Streets.

Editor American Machinist:

No doubt most of your readers have experienced the difficulty of finding their way in a strange place at night. Whilst the streets in many of our large cities are, I regret to say, poorly marked, yet by dint of inquiry and the aid of an occasional sign one can get about in the day time much more readily than at night. I deem the problem well worth thought, and should like to see the best ideas discussed in your columns. I have a little scheme in which perhaps there is merit: viz., to place on the lower side of the globes of our arc lamps on the street corners and on the side facing the proper street a small sign, either cast or stamped from a sheet of proper material, and bearing its name in open letters arranged to read from right and left (backward), this sign to be supported by a proper frame attached to the lower part of the lamp and in such a position that the light will throw a dense shadow on the ground below. The addition of an arrow or hand pointing to the north in one instance and in the other to the east, would add to its usefulness. But for the expense of renewal in case of breakage it would be well to paint the sign directly on the globe.

The letters can be made small enough not to interfere with the light and yet be quite plain, owing to the magnifying power of the globe.

I trust that this suggestion will lead to better ones, and thus accomplish something in the end. A. S. MALLORY.

Wants to Make a Test of Skill.

Editor American Machinist:

In your issue of June 9th we read a very disparaging article on page 4 in reference to horological schools.

That a reporter should listen to the silly vaporing of a conceited old member of the craft of watchmakers, is not to be wondered at; but that the editor of a progressive journal, doing so much toward educating mutual workers above the mere routine of chipping and filing, should tacitly sanction such puerile nonsense is something quite unexpected, to say the least. There is an old adage which has borne sanction for a long time, "that a man shall be known by his works," and as a very simple proof of the ability of the American Horological Institute to instruct in the art of watchmaking, we propose to the veteran of the file and graver referred to, and who has so much faith in his own superior acquirements, that he compete with a graduate of our school in a matter of skill. He to deposit $50, we $100, and the most skillful workman to take the pool; the test productions to be either a detent for a marine chronometer, a lever escapement to match a foreign watch, or an original train for a watch, consisting of a going barrel, center wheel, third and fourth wheels set either in full plate or lower plate with bars and cocks so as to judge of depths. Judges to be selected, one by the veteran and one by ourselves; they to choose a third. Nothing beats a trial, even in puddings.

We note that the excerpt referred to was taken from the *Mail and Express*. We trust that you, as a journal doing what is possible to advance the mechanical world, will give us a hearing in your journal in a future number.

WM. H. DOTTER,
Secretary American Horological Institute,
Philadelphia.

Used Graphite.

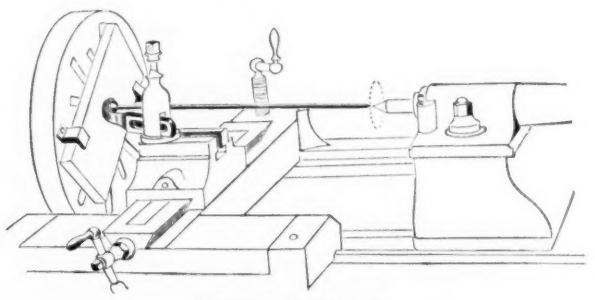
Editor American Machinist:

We have read with much interest in your issue of July 28th the remarks by Mr. T. T. Parker regarding pitting in boilers, and the successful use of graphite and oil for preventing the increase of pitting already done, as well as the formation of new pits. In addition to his testimony, we should like to call your attention to the experience of Messrs. Harig, Koop & Co., Louisville, Ky. After having more or less trouble from rust and scale in the mud drums of their boilers, they applied with great success graphited oil. The mud drums were cleaned out and the graphited oil applied with swab, brush, or anything handy to the joints and parts where the water enters the drums Every four or six weeks this process is repeated with the most gratifying results.

JOS. DIXON CRUCIBLE CO.

Freight Steamship "Naronic."

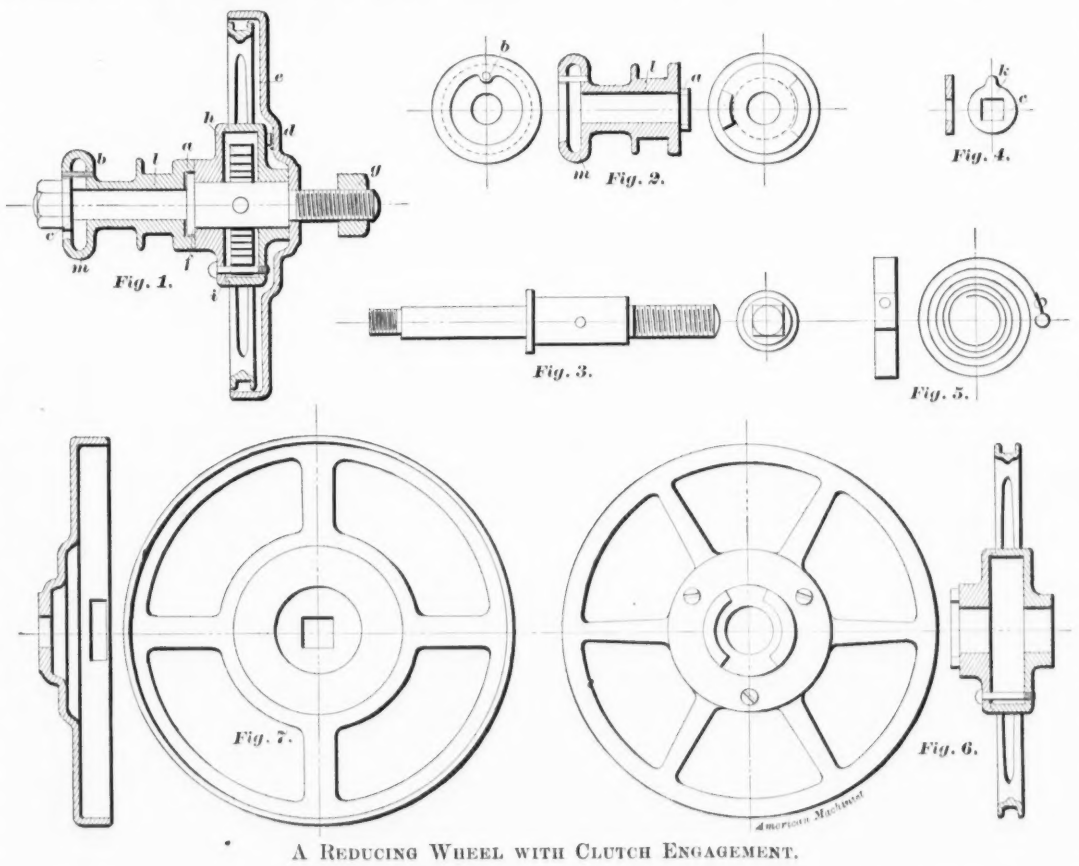
The freight steamer "Naronic," specially designed for the transatlantic freight service, is the latest addition to the fleet of the White Star Line. She is a twin screw steamer, each propeller being driven by a separate engine of the triple-expansion type, thus reducing to a minimum the chances of a breakdown and consequent delays in arrival. Her length is 470 feet; breadth, 53 feet; and depth of hold 35 feet 6 inches. The ship is replete with all the most approved equipment for the comfort and safe carriage of horses—amidship—cattle, fresh meat, fruit and general merchandise. She is capable of carrying 1,050 cattle on her upper and main decks. The most careful considerations have been given to the accommodations, and every improvement that experience can suggest has been made. Four other steamers—the "Nomadic," "Tauric," "Cufic" and "Runic"—have previously been and are now used in the same service. Since the beginning of the present year these four steamers have carried 11,248 head of cattle, of which only thirteen have been lost. During the same period 238 horses have been carried, out of which only three were lost, and those from natural causes. This augurs well for the advancement made in this kind of service. The advancement made in steam engineering also enables the steamship companies to increase the speed of their freight steamers without an excessive expenditure in coal. The "Naronic" made her maiden trip last month, from Liverpool to New York, in 9 days 4 hours and 21 minutes, which beats the best first trip of any cargo steamer afloat. Her sister ship is now nearing completion, and, when added to the fleet, a service will be established which will be unique and unrivaled in speed and accommodations for the shipment of live stock and freight, and will no doubt play a large part in the carrying trade between this country and Europe. The "Naronic" was built by Messrs. Harland & Wolff, Belfast, and is claimed to be the finest freighter at present in the service.



CENTER INDICATOR.

A Reducing Wheel with Clutch Engagement.

In indicating high-speed engines, especially the vertical types, it is frequently inconvenient to make use of the ordinary hook and loop for stopping and starting the pencil drum. With a view to obtaining a handier and more satisfactory means of engagement and disengagement, the apparatus illustrated here was designed and made by a few of the senior mechanical engineers of the Lehigh University.



A REDUCING WHEEL WITH CLUTCH ENGAGEMENT.

Fig. 1 represents a section through the instrument, the principal features of which are easily distinguishable. The large wheel (Fig. 6) is separated from the small pulley by a clutch at *a*, and is prevented from endwise motion by the collar *f* of the stud on one side and the guard *e* on the other, when the nut *g* is screwed up tightly against the engine bracket. By means of the spring *h* (Fig. 5), held by the stud at one end, and grasping one of the three cap screws of the spring-box at the other, the necessary tension in the crosshead cord is obtained, the motion of the wheel being limited to a trifle less than one revolution by the stop at *d*.

The small pulley *l* (Fig. 2) is provided with a knob *m* for throwing the clutch *a* in and out of gear, and its motion is also limited to nearly one revolution by the stop *b* butting against the swell *k* of the washer *c* (Fig 4). The shape of the clutch is such that engagement can take place in only one relative position of the pulleys, but at any point of the stroke of the engine.

When the clutch is pulled out, the stop *b* of the small pulley drops against the swell of the washer, thus preventing slack in the cord leading to the indicators. No special spring is required for keeping the clutch in gear, friction alone being sufficient for this purpose, and it is impossible for the clutch to work into gear of its own accord after being thrown out.

The large wheel is 5⅛ inches in diameter, and the small pulley in the present case a little more than one inch. Both are made of aluminum in order to reduce the momentum of the moving parts as much as possible. When the device was in process of construction, doubts were advanced as to the feasibility of operating a clutch of the kind used, with square teeth, on high speeds, but no difficulty whatever has been encountered so far in throwing the clutch in or out at speeds approaching close to 300 revolutions per minute. Undoubtedly the arrangement can be improved more or less in its details, but the present form may serve to illustrate the principle, and has given entire satisfaction for heavy service, *i. e.*, for driving four indicators on a tandem compound running at the speed given above.

Center Indicator.

Readers of the AMERICAN MACHINIST need not be told of the uses or advantages of the center indicator for truing up work on the lathe face plate or in the chuck, its utility and several forms of the tool having been illustrated and discussed by practical men in our columns. This tool has now been made a regular article of manufacture by the North Electric Works, of Cleveland, O., whose center indicator, with the manner of using it, are illustrated by the accompanying engraving.

The tool consists of a stock $1'' \times \frac{7}{16}''$, which goes into the tool-post the same as a tool. At the end of this is a flat spring, which carries at its outer extremity a spherical socket into which a ball fits, this ball being held by a set-screw at any desired point on the wire. The spring is "off-set," so that the center of motion of the wire can be brought as close to the work as desirable without interference with clamps, bolts or chuck jaws, and serves to keep the point of the wire in the center mark with just the desired pressure. The point of the wire which is put to the work is of hardened steel, this steel wire being about 2" long and the balance—9"—of aluminum, to give lightness and lessen the liability to troublesome vibration which is often encountered with wires that are heavy in proportion to diameter and length. The entire tool is nickel plated, well made, and, of course, furnished at a price far below the cost of such tools as usually produced, which, however, as our readers know, do not cost more than they are worth in any shop where good work is done, provided they cannot be obtained upon more favorable terms.

A correspondent asks us if there is a machine made and for sale for making auger-bits. So far as we know, machinery for this purpose has been specially designed and built. We shall be glad to hear to the contrary.

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FRED J. MILLER, }

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☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

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NEW YORK, AUGUST 11, 1892.

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New Ocean Records.

The steamer "City of Paris" is once more queen of the seas, having again set the pace for ocean steamers traveling westward, beating the time of the "Teutonic" by 33 minutes.

Very seldom does an ocean racer secure uniformly favorable conditions for a record-breaking trip, and in this instance there were four hours of slow running on account of fog, and the port engine was stopped about half an hour on account of the breaking of one of the cap bolts of the crank-shaft bearing abaft the low pressure crank.

The writer, who visited the steamer while lying in port after the run, saw plenty of evidence of the severity of the strain to which everything is subjected on these fast trips, and the work that must be done on the engines and boilers while in port, in order to keep them up to their full efficiency, would surprise the engineer of the ordinary stationary steam plant.

The "Teutonic," of course, tried in her last trip to regain the record, and succeeded in making the largest day's run—528 miles—as against the "City of Paris'" 520 miles, but failed to lower the record, the reason given for the failure being an accident to one of the engines which necessitated its stoppage, and the completion of the voyage with only one engine running. Breaks do not count, however, in ocean racing any more than slips in horse-racing do, and the best vessel is not the one that could have lowered the record if the engine had not broken, but the one that actually lowers the record.

The month of August is usually the most favorable month of the year for breaking and making new records, the condition of winds and waves being then usually the best of the year, and we may expect to hear of more quick trips before the month is out. At this writing the "City of Paris" is on her outward trip, and it is tacitly understood that she will try to gain the pennant for the quickest eastward trip also.

A significant thing in the performance of the "Teutonic" is that for twenty-four hours she steamed at a rate above the contract speed of the new cruiser the "Columbia," one of the objects of this cruiser being to overtake and capture any merchant ship.

Ferry Changes.

It seems now as though before either the Hudson River tunnel passing under, or the proposed bridge which is to pass over the river can be completed, a good deal of the unpleasantness experienced in crossing by ferries will be done away with. The advent of the "Bergen," in which the old side-wheels were done away with, and a screw at each end of the boat substituted, made the ferriage more satisfactory in points of speed and comfort, as well as by furnishing a boat remarkable for elegance of interior finish. This was followed by boats in which an upper deck was added, thus increasing carrying capacity and adding to the comfort and pleasure of the trip. Now it is announced that boats are to be put on that are to be devoted exclusively to the use of passengers, the present boats being used for teams of all kinds, including those which in many cases draw loads which one would naturally prefer to keep as far away from as possible. With passenger ferryboats the time of loading and unloading can be shortened, and thus the time of trains between New York and suburban places reduced, this time being of course always counted from the time the boats leave or touch upon the New York side. It is understood that the Harlan & Hollingsworth Company are building two new boats for the Jersey Central road, and the Reading is to have two new boats that will land, passengers only, at the Battery, where they will be in direct communication with either of the elevated lines or with the Broadway cable road, without the necessity for walking or traveling by horse cars across the city. All these boats, it is understood, are to be fast, and the time seems not far distant when the men who now cross the river every day will be able to tell how they used to accomplish the journey before the introduction of modern improvements in ferry travel.

Mechanical Engineering at Leland Stanford, Jr., University.

In our account of the visit of the Mechanical Engineers to San Francisco, we gave some facts concerning the newly established Leland Stanford, Jr., University, at Palo Alto, its equipment, and what it is proposed to do there in the way of instruction in mechanical engineering under the leadership of Prof. H. B. Gale. Prof. Gale has furnished us with some advance sheets of the forthcoming catalogue of the University, from which we make the following extracts as going to show the modern tendency in such instruction as it is proposed to give there.

The aim of these courses in mechanical engineering is to give the student such training as shall enable him to deal with engineering problems in the design and construction of machinery, and in its application to useful purposes.

The work includes as a foundation a study of mathematics and of the physical laws, by whose application the sources of power in nature—gravitation, heat and electricity—are made available in doing mechanical work. It embraces also the practical investigation of the strength and other properties of materials and of the various workshop processes by which the materials used in machine construction are fashioned to the desired forms.

The laboratory method of instruction, where it can be employed, is preferred to the use of text-books, and the work above outlined, with the exception of pure mathematics, is mainly carried on in the physical and testing laboratories and in the workshops. The ordinary course in the shops extends over three years, and includes in succession, practice in wood work and pattern making, foundry work, and work in the blacksmith shop and the machine shop.

These courses are accompanied by a class-room study of the principles of mechanism, of the laws of friction, and of the proportions, strength and efficiency of elementary machines. An effort is made also to acquaint the student as far as possible with examples of the best modern practice in machine tools, and in machinery for the generation and transmission of power.

The general work in machine design consists of parallel courses in the class-room and the drafting-room, the drafting-room work consisting in the graphical solution of problems in which the principles discussed in the class-room are illustrated. There are no problems of this kind, however, in connection with the study of materials, and advantage is taken of this opportunity to give to the student problems that are adapted to the cultivation of the inventive faculty. That is, the student is required to accomplish certain results in a machine with the greatest simplicity, efficiency, and convenience to the workman who is to operate it. Considerable attention is given to the computation of the sizes of machine parts, and in this work reliance upon set rules or formulas is discouraged, the object of the exercises being to develop the student's power of applying to his problems those fundamental principles which, once at his command, will enable him to solve new problems as they arise.

The most advanced study of mechanical engineering is naturally divided into branches, according to the various special purposes to which machines are applied, and the different kinds of forces employed in them. When a student has mastered sufficiently the general principles of machinery, he may choose freely any one of a number of special departments which he desires to make the object of further study, options being offered in Stationary Steam Engineering, Electrical Engineering, Mill Engineering and Construction, Marine Engineering, Railway Machinery, Hydraulics and Hydraulic Motors.

There are numerous rumors afloat regarding new schemes for compressed air propulsion, the air to be used in some very unique ways. At Plainfield, N. J., it is said a system is to be put in which, it is announced, will be perfect. The rails in this system will be hollow, and filled with air at 2,000 pounds pressure per square inch. Along the rails will be valves placed at intervals equal to one-eighth the circumference of the wheels, and on each wheel will be eight "protuberances," which will act to open these valves and allow some of this compressed air to escape and act on the periphery of the wheel just back of the point of contact, thus giving the wheels a "strong rotary motion." It would seem as though such a crazy scheme as this would never get very far, but it is nevertheless stated in a usually reliable paper that the people of the town are entering into the project enthusiastically, and that the road is to be completed by October 1.

At the same time, it may be said that there are some efforts being made to introduce compressed air for motive power on street railways, which efforts are being guided by engineers who, by experience and study of the subject, have earned the right to respectful attention. In these latter schemes, as might be expected, nothing revolutionary is to be attempted, but the air is to be compressed at a central station, delivered to locomotives which will carry it in strong steel storage cylinders, and use it in cylinders fitted with pistons and valves, a moderate amount of reheating being done immediately before using the air, as it has been found economical to do. The initial pressure in the storage cylinder will be moderately high—about 300 pounds—and it will run down to something less than 100 before recharging, speed being regulated by changing the point of cut off, by throttling, or by both. It is not claimed that this will be economical as compared with a locomotive using steam, but it will have manifest advantages aside from economy for urban roads.

Machinery at Chicago.

A press dispatch announces that the machinery department at Chicago is likely to be very much crowded, and that in the allotment of space, which is soon to be made, only about one-third the space asked for by exhibitors can be given.

We think this is very much to be regretted, for it means nothing less than that the machinery interests of the country are not to be adequately represented; and we can think of no interest which, in the present state of our industrial and commercial development it is more important to us as a nation, should be thoroughly and completely represented.

It does not, of course, follow from this that the machinery exhibition is not going to be a great one, for there is every indication that it will far surpass every previous gathering together of machinery. But this is not enough, and does not come up to what we had hoped to see at Chicago. There are machinery builders who will find upon trial that they can get along very well and make a fairly creditable showing in one third the space asked for, but there are others who will find this difficult, if not impossible. Indeed, we fear that some who have applied for space may conclude not to try to exhibit in one third the space asked for.

The fact seems to be that there has been a failure upon the part of some one to get an adequate idea of the enormous increase in the volume and variety of machinery made and used since the Centennial Exhibition. Not only has there been a tremendous increase in the number of machinery establishments since that time, but most of the older establishments that exhibited at Philadelphia are now building a much greater variety of machinery, much of it a great deal larger and heavier than was dreamed of in 1876. It is probable that an inadequate idea of this growth and development prevailed at Chicago until applications for space began to come in, and that ideas there have been expanded by experience is shown by the fact that Machinery Hall is to be nearly twice as large as the original plans called for, this being, so far as we know, the only building which it has been found necessary to enlarge, after the original plans were drawn.

It seems as though all that is necessary in order to have a machinery exhibition about three times as big as it will be, is to provide space for showing the machines; the machinery manufacturers of the country having evidently done their part—thus far, at least—towards making the exhibit a full and complete one.

Getting the Paper Through Newsdealers.

Readers of the AMERICAN MACHINIST, who have difficulty in obtaining copies of the current issue at the news stand where they are in the habit of ordering, or where it would be most convenient for them to procure it, will confer a favor by dropping us a postal card stating the fact. To make the information effective, however, either the name or location of the newsdealer, or both, should be mentioned, not for the purpose of causing him embarrassment, but to enable us to improve our facilities for his prompt supply.

In like manner it is our intention to provide facilities enabling back numbers of the paper to be readily sent for and procured by newsdealers, with as little delay as may be practicable for the transmission of the order and the forwarding of the desired copies. In placing such orders, however, time will be saved by stating either the date or number of the issue wanted, wherever possible to do so.

Readers having difficulty in procuring such issues, also, through newsdealers, will confer a favor by informing us.

A correspondent writes the Jos. Dixon Company, of Jersey City, N. J., referring to an article on the use of graphite that recently appeared from a correspondent in the AMERICAN MACHINIST, as follows:

"Let me say that I have used graphite for many purposes, some that the correspondent did not name, which I will give, as it may benefit some of my brother engineers, who perhaps have not experimented to any great extent with the article. I have used handhole and manhole gaskets eight to ten times by carefully smearing the surface next boiler shell, taken out at periods of three to four weeks, using steam pressure as high as 100 pounds. In packing water glasses, by putting a little graphite and oil on the gasket they would volcanize as soft as lamp-wick and retain their elasticity until the glass was changed, when the old rubber could be removed without trouble, while by the old way, I have spent much time in digging out the rubber, baked hard as vulcanite. Another thing I used it for was after putting back my handhole plate or plugs in back connection, I carefully brush away all the soot and ashes, then with a small brush paint a good coat of graphite over flange, stud and nuts. After running boiler from three to six months, and using coke for fuel, with forced draught, the nuts can be removed without trouble as the heat has not been great enough to burn the lead."

Literary Notes.

We have received a copy of the Introduction to Poor's Manual of the Railroads of the United States for 1892, which gives a collection of statistics of railroads for 1891. The year is not covered precisely by the figures given, however, for the reason that the publisher must take the reports of the various roads for fiscal years which end at different dates on different roads. Nevertheless the report as given for 1891 is probably very nearly correct in all important particulars. The increase in mileage for the year is given as 3,899 miles, which is a falling off of 1,450 miles as compared with 1890. The total mileage as given is 170,601 miles. Practically all of this is laid with steel rails, the mileage of such rails used on sidings more than equaling that of main track laid with iron rails. Some of the most interesting facts with regard to increase of locomotive efficiency are deducible from the tables given when compared with similar figures for previous years, the average freight train load in tons being now 164.6, as compared with 128.8 tons in 1882, since which time it has been steadily increasing. The "Introduction" is filled with the most interesting and valuable statistical matter, and may be obtained of the publishers, H. V. & H. W. Poor, 70 Wall street, N. Y. Price, 25 cents.

A correspondent writes us; I would like some of the readers of the AMERICAN MACHINIST to give me a suitable mixture of iron to cast hydraulic cylinders which are required to stand a high pressure. Want it strong, close, and soft enough to work nicely under the tool.

A correspondent wants to know what has been done, and is being done, in the way of using pulverized fuel in the furnaces of steam boilers. We shall be pleased to receive replies to his inquiry.

E. C. Atkins & Co., saw manufacturers of Indianapolis, Ind., have introduced a system of profit-sharing in their factory which has worked well for a year, and is to be continued.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(332) C. A. P., Lockport, N. Y., writes: Please give me through your columns the address of manufacturers of veneering machines. *A.*—Write to any manufacturer of wood-working machines; the address of some of these you will find in our advertising columns.

(333) R. S. E., Stevens Point, Wis., writes: Kindly answer through your columns the following: What is the best size of steam and exhaust ports, width of bridges, size of valve and travel for a 4x4-inch launch engine? Also give throw of link. *A.*—We should make the steam ports ¼ inch wide by 2½ inches long; exhaust ports, ½x2½ inches; width of bridge, $\frac{5}{16}$ inch; lap of valve, $\frac{5}{16}$ inch; travel of valve, 1¼ inches; distance between centers of eccentric rod pins in link, 3 inches.

(334) Reader, Philadelphia, Pa., writes: Please state in your columns what is the fastest public record of a mile ever made by any steamboat or steam launch in America, also when and where such record was made. *A.*—The steam launch "Norwood," built by C. D. Mosher, developed a speed of 30 miles an hour during a two hours' run over the Wannesquam Boat Club course July 8, 1890. It is claimed that this speed has been exceeded by the same boat, but we have no record of it.

(335) B. C. P., Baton Rouge, La., writes: Please give me through your columns directions for cutting the sides of a boat 20 feet long so that I can run it with two paddle wheels about 3 feet in diameter. I want a light boat to carry about three to four persons. *A.*—In our issue of June 4, 1891, you will find illustrations and the lines of a boat with full instructions of building one. We do not see the object of building a boat 20 feet long for carrying only three to four persons when a light boat is desired; a shorter boat will answer the purpose.

(336) E. S. S., Sterling, Ill., writes: Please inform me where I can get a book giving the wages of skilled and unskilled labor in the United States and Europe. *A.*—The annual reports of the Commissioner of Labor, Washington, may give the information you seek. The last report treats mainly with the cost of production of iron and steel, and the materials of which iron is made in the United States and in Europe, and the earnings, the efficiency, and the cost of living of the men employed in such production. We know of no other authentic work of this kind.

(337) C. S., Newark, N. J., writes: Kindly give me through your columns a little information on the mixture of Babbitt metal. I would like to cast a nut of this metal for a screw. *A.*—Melt separately 4 parts of copper, 12 Banca tin, 8 regulus of antimony. After fusion add 12 parts more of tin. The antimony should be mixed with the first portion of the tin, and the copper added after taking the melting part from the fire. The surface of the charge should be protected from oxidation by a covering of powdered charcoal. This mixture constitutes the *hardening*, and the Babbitt metal is made by fusing 1 part of this hardening with 2 parts of tin, thus making the metal consist of 3.7 parts copper, 7.4 parts antimony, and 88.9 parts tin.

(338) R. W. K., Pottsville, Pa., writes: I am seeking information regarding a specimen of earth, and although it is not of a mechanical nature, I am in hopes you will kindly answer through your columns and greatly oblige an old subscriber. I have a sample of earth, gray in color, and shows by analysis that it is composed of moisture 6.46 parts; combined water, 14.94 parts; silica, 72.9 parts; alumina, 4.88 parts; oxide iron, 0.9 parts. I would like to know what it is good for? Could it be used in making glass? Has it any value? The above analysis may not be exactly correct, as the quantity analyzed was very small. *A.*—The manufacture of glass is out of our line, and we do not know whether the earth to which you refer is suitable for the purpose; neither can we give an opinion as to its inherent value. Some of our readers may give the desired information.

(339) M. E., New York, writes: I am a foreign mechanical engineer, and I find some trouble in using my text books on account of the different system of measurement and practice. I would like to know which is the best manual for a mechanical engineer to use in the drawing-room? *A.*—You have undoubtedly the German edition of "Mechanics and Engineering and of Machinery," by Dr. J. Weisbach; get the English edition of the same work and compare and study these in your leisure hours in the evenings, as you will probably not have the opportunity to do so in an office. If you have had a thorough technical training you should have no difficulty in applying your knowledge to American practice, as the theoretical part of it does not differ from that in other countries. The practical branch you can gain only by experience. 2. Please give me the name of a work treating on metal working according to the American practice. *A.*—Write to any dealer in scientific works for a catalogue; the addresses of some of these are given in our advertising columns; this will enable you to make a selection better than we can, as we do not know your requirements. A glance at the books in a public library is often a great aid in making the proper selection. 3 Can you give me an idea of the salaries paid to mechanical draftsmen in this country? *A.*—That depends greatly on your ability, the kind of work you are engaged on, and the locality in which you work. Some draftsmen get about the same pay as a machinist and others from three to four times as much.

(340) T. W. R., Prince's Bay, N. Y., writes: Kindly answer the following questions through your columns. Are the following rules for finding the diameter and length of any square or V-threaded screw, or bolt, correct? If not please give me the right rules. Rule 1. The working load in tons on any square or V-threaded screw or bolt being given, to find the diameter in inches (measured at the bottom of the thread) divide the load by 4, and extract the square root of the quotient; the result will be the required diameter. The safe working load per sectional square inch of the body of the screw or bolt is, in this rule and the following ones, assumed to be 4 tons. *A.*—This is an empirical rule, and for ordinary work will give satisfactory results. Care should be taken in selecting the proper value for the stress per square inch of section, as this will vary with the quality of the material. It may be mentioned that the proper way to find the diameter is to divide the working load by the allowable stress per square inch, and again divide this quotient by .7854, and then extract the square root of this last quotient. Rule 2. The diameter in inches (measured at the bottom of the thread) being given, and also the working load in tons, it is proposed to work under to find the correct length in inches of the screw, divide the given load by the given diameter, and by 9.4; the quotient will be the required length. Rule 3. To find the necessary length in inches of any square-threaded screw or bolt, divide the given working load in tons by the given diameter in inches (measured at the bottom of thread) and by 6.3; the quotient will be the required length. *A.*—These rules will not give satisfactory results. The depth of the nuts for ordinary bolts is made equal to the diameter outside of threads; for nuts which have to be loosened very often, or for nuts which have to move loads along the screw, the depth should be from one and a half times to twice the diameter. No regular rule can be given; experience and good judgment is required for determining the length of nut to suit the various conditions under which it has to work. 2 Having obtained the diameter and length, how shall I proceed to find the correct dimensions of the thread corresponding to the given diameter? *A.*—Refer to a table giving the "Franklin Institute Standard" of bolts and nuts, which will give you the dimensions of threads. A table of this kind you can find in any good engineer's pocket-book.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant Gear Wheels, Gear Cutting, page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

A. D. Pentz, Consulting. Tools. Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure: forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Holbrook's new loaded rawhide mallets.

Automatic Gear Cutters. Best in the market. Superior Machine Works, 106 Canal St., Cleve'd, O.

Pulley lathes, most efficient offered. Ohio Machine Tool Works, Cincinnati, O.

J. S. Thurman, M. E., Indianapolis, Ind., Expert Patent Solicitor. Inventions Perfected.

Corres. with parties having special mach'y to build. Kollmyer & Talbot, Keokuk, Iowa.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

25" 32" 37" 42" "Only Drill Press built on 'Ko-rekt' principles, Even if they come from Jersey." Gould & Eberhardt, Newark, N. J.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

The Technical School and the Shop.

BY PROFESSOR JOSEPH TORREY.

There is no more decided evidence of the far-reaching character of our modern civilization than the present relation between the school and the shop.

History may be repeating itself here as in many other places, but the old tracks are well covered. The so-much-mourned "lost arts," quite likely over-estimated in many cases, both as to extent and importance, seem at first sight to point to a time when scientist and artisan were as closely related as they are now, perhaps even more so; but a careful scrutiny of the fragmentary traditions which have come down to us fails to confirm the surface indications.

As we still further study history, it appears that the union of science and shop-craft, although apparently the natural consummation to look forward to, has in all times met with much the same obstacles.

Imperfect theoretical knowledge has always hindered the theorist in his endeavors to improve existing practice. Mechanics have been uneducated and dogmatic. Add to these the relentless current of *business*, a product, be it noticed, of civilization itself, and we have the life-blood of the time-honored belief that theory and practice are irreconcilable.

In our own times theoretical knowledge has become at once more thorough and more widely disseminated. Mechanics are, on the average, much better educated, but business has grown correspondingly. The result is that while an approach has been

made toward an understanding between the theorist and the practical man, progress is relatively slow.

The history of the growth which has led up to the possibilities of to-day would be fit material for a volume. The purpose of the present article, however, is simply to consider the relation of this progress to schools and students.

In the first place, then, we find that many of the great industrial developments of the present had a distinctly scientific birth. Their growth in many cases has not been correspondingly scientific, but there has always been a hope that it would be sometime, and it may be truly said that this hope has revolutionized our whole educational world. Twenty years ago the courses afforded by our schools and colleges were about as far from being technical or industrial as they well could be. Indeed science, except as a mere smattering, was no essential part of a liberal education, and technical schools, pure and simple, were almost unknown.

To-day we have rectified that error, and perhaps over-rectified it. Technical schools have sprung up all over the country. Our colleges have departed from their traditions somewhat, and have greatly increased their facilities for scientific instruction. The students of the present day have felt the thrill too, and it has made them as a class impatient of the old college curriculum, and turned them toward the technical schools.

Many of those who would never have gone beyond the high school course now turn their faces in the same direction, and as a result, our technical schools, now numerous and well endowed, are filled with students of all degrees of maturity, from the college graduate to the boy with only an indifferent school record behind him.

Students who have completed their course of training may be divided roughly into two classes; first, those whose main idea is money, and who care comparatively little where they are placed so long as they are doing well financially; and second, those who are ambitious, more especially for scientific distinction, who from natural bent, aided by judicious study and practice, have attained particular excellence in some department, and hope sometime to be so placed that they may be able to add something to the world's knowledge, or perhaps facilitate man's work by their own devices.

The first class may be subdivided so that we may consider by themselves a relatively small class, who have shown great aptitude as machinists, and who are genuinely in love with the work, but have no marked originality. These may perhaps help to fill the ranks of really skillful workmen.

I see no reason why we should so often disregard the possibilities of technical school as a source of good machinists.

Occasionally such men are simply immature when they go out into the world. If they mature amid large surroundings, they may outgrow their shells and become engineers, but it is not commonly the case. Nature rarely combines the peculiar qualities necessary to the engineer with those that go to make up the fine workman.

The second class of students may be also subdivided, so as to place by themselves the small class who will make real engineers, whose distinguishing characteristic is *grasp*, and who will manifest the breadth of vision and sense of the "eternal fitness of things," so essential to one who is to lay out and direct great undertakings. For this class there will always be room.

The most perplexing problem is presented by those who, wherever and whatever they are, will always be students and investigators. The manufacturing world is full of inviting chances for investigation, but young students are often led to far underestimate the great difficulties which such investigations present. Encouraged by well-meaning friends (who, it must be feared, have not always a very exact knowledge of the actual conditions, but only a vague idea that there are "improvements" and "inventions" to be made) these young men seek and obtain positions in large manufacturing establishments, expecting to find there great facilities for "experimenting," and, in short, a genuine atmosphere of technology.

Sometimes the result is gratifying, but in most cases not, for several reasons.

In the first place, competition in trade, necessity of keeping in the market at all hazards with *something*, and the cost of changing from one set of patterns and jigs to another, together with the added possibility of having to change more than once before everything is satisfactory, largely preclude the possibility of much experiment in the dark. Most builders, as a matter of fact, either follow closely the practice of their competitors, or are guided by their own experience. The work of designing with them being largely a matter of "rule of thumb."

As previously remarked, sometimes the case is different. I have known several young men who have made great successes in this way, but in *every case* there was a combination of the requisite amount of scientific knowledge with practical skill and good sense, a combination which means success anywhere. I have known many more cases where the failure was complete and decided.

It may be said that the experience in a large establishment is valuable, and to a limited extent it may be; but the work is apt to be a confining routine with little time for study, and little prospect of advancement.

Chemistry is constantly held out as a tempting bait, and there are some good openings in this line, particularly in connection with iron or steel works, pulp-mills and dye factories, but in the main, the bait is red flannel. There is practically nothing in analytical chemistry. Competition is very sharp, and the resulting low tariff carries the work into the hands of old established firms who have other anchors out to windward.

The state of things at present is, in fact, about as follows: There is hardly a manufacturing industry that has not received a direct impulse from applied science, but it has been a real impulse, not a steady, ever-present effort. Sometimes a single idea, sometimes a discovery, opening up all the side industries that always accompany a new manufacture. The result has been a general quickening of everything, and the one idea just now is to keep in the market. So the manufacturer is "going it alone," and for the time being the technologist seems to be unable to fit into the combination as advantageously as he could a few years ago; but nothing is more certain than that there will be a change. There are already signs of it in the air. Manufacturers are waking up to the fact that they are wasting thousands of dollars in blind experiment, when a rightly understood and applied dose of theory would bring them to the result in less time and with less expense.

In no industry is this so true as in electricity. The state of things is understood by those who direct and control this great manufacture, but the case is a very complicated one. Orders are always far ahead of capacity. Expensive lawsuits on patents and infringements, together with the necessity of enlarging the works at every possible opportunity, absorb time, attention and money.

But the time is coming when progress will have reached its maximum under the existing circumstances, and the stimulus will be sought in a new and more complete study of remote theoretical points—points perhaps hardly thought of now. It is not by any means certain, be it remembered, that we are on the right track at all now in this matter. We have brought the steam engine to a point where little more is to be looked for from a thermodynamical point of view, and yet how far we are from a quantitative conversion of heat into work. The dynamo seems to promise well, but it is a long distance from grate bars to commutator. The future may—probably will, we may predict—see a solution of this great problem, which will show how far we have been driven from the true straight track; but if such a solution is reached, science—and pure science, too—must reach it; not develop it and bring it down to the manufacturer's hands—that is not the domain of science; but the first hint that will bring about the new era will probably come direct from the physicist's laboratory.

If this is so, then it certainly seems as if the place for the young man, who would have a part in the new order of things, was in the physical laboratories. Improvements in the dynamo and steam engine are all very well, but they are not in the line of "the powers of the world to come." The research which is to be victorious must proceed along unbroken paths, and, perhaps, where least anticipated, the solution will be found.

Those who have not the far sight of the investigator, but who wish to have a part in the work, can see that the world has within its reach the theoretical knowledge already accumulated. There is a life work in the task of translating the books of the great engineers Rankine, Mosely, Weisbach, and many others into language which the non-mathematical builders can understand. Without any further study or investigation the mechanic arts would be imbued with new life by the plain, simple promulgation of principles, which these master minds could not utter in language less profound than the principles themselves.

Waterford's Oldest Manufacturer Dead.

George Gage, the oldest manufacturer in Waterford, died at his home on Second street yesterday afternoon shortly after 5 o'clock. Mr. Gage was one of Waterford's foremost citizens, being heartily in support of any measure that would advance the interests of the town or village or tend to its growth. He was a member of the citizens' committee that named the commissioners for the building of the town hall, and was foremost in advocating the erection of the new school building. Mr. Gage was nearly six feet in height, but his slight build made him appear taller, and his erect form was one of the looked-for objects on the street every day. He carried a cane, and would pleasantly accost every man or child with a slight tap and his peculiar expression, "How do, boy?" George Gage was born in Enfield, N. H., October 20, 1804. He was educated in the common schools of that town, and in 1829 went to Waterford, where he shortly afterward embarked in the manufacturing of machinery in the large building in which his shop was located at the time of his death. In 1834 he was married to Mary Whitford, who died in February, 1885. One son, John E. Gage, who has been honored as supervisor of Waterford for many terms survives. He has conducted the business of his father for the past few years. George Gage has served as village assessor for over twenty years. He was formerly a Whig, but on the formation of the Republican party joined it, and had been a strong adherent of it since. His funeral will occur to-morrow afternoon.—*Troy* (N. Y.) *Press.*

The head of a live steam feed-water purifier recently blew out and made considerable of a wreck of surrounding objects, one manifestation of its force being the moving of a six-ton rock which was situated about twelve feet away. A contemporary, commenting upon this, says: "Usually the head of a purifier is not of very great weight, and the distance which it traveled before striking the rock was but short, and yet it was shown that the force was sufficient to move the rock about three feet." We wonder what our contemporary's theory is with regard to this matter of the effect of distance moved by a flying object. Is it supposed that the force with which it strikes increases with the distance moved, and, if so, in what proportion does it increase?

The Indian, it is said, measures distance in canoeing by "pipes." One pipe is the interval between the haltings he is allowed to make for a smoke.

MANUFACTURES

The Doniphan (Ripley Co., Mo.) Roller-mill Company is a new $7,000 concern.

The Rio Grande Western Railroad will establish machine shops at Ogden, Utah.

A tin-plate factory is talked of at Williamsport, Pa. Fred Weddigen is interested.

The Warwood Tool Company, Wheeling, W. Va., has been organized, with $100,000 capital.

The Sharon Hill (Pa.) Electric Light Company has been organized, with $1,000 capital stock.

The Lamokin (Pa.) Car Works Company is still discussing the feasibility of erecting new shops.

The Hashuqua Manufacturing Company is talking of adding new machinery to its plant at Shuqualak, Miss.

The Grant Machine Tool Works will erect a new building, 60 feet long, at their plant at Fitchburg, Mass.

The Glover Foundry Company, of New Castle, Pa., will shortly erect a plant for turning chilled rolls.

The Lynchburg (Va.) Cotton-mill will put in additional machinery, including 5,000 spindles and 300 looms.

The steam power at the Globe Mills, Woonsocket, R. I., will be increased from 900 to 1,200 horse-power.

J. M. Couper, of Cave Springs, Ga., is organizing a company to build a ferro-manganese furnace at that place.

It is stated that the Ingersoll-Sergeant Drill Company will remove its plant from New York City to Easton, Pa.

The Stamford (Delaware Co., N. Y.) Electric Light Company is a new $20,000 concern. Isaac Maynard is a director.

The Ledig Manufacturing Company, Philadelphia, Pa., has been capitalized at $100,000, to manufacture iron, steel, etc.

A new Indiana corporation is the Cambridge City Punch, Shear and Roll Company, with a capital stock of $50,000.

The Self-cleaning Mortise Chisel Co., Limited, has been chartered at New Orleans, La. The capital stock named is $250,000.

William E. Clarke has petitioned the city council (New Orleans, La.) for permission to erect an iron foundry and machine shop.

Citizens of Randolph (N. Y.) want to establish a foundry, and will give the necessary land if outside capital will go into the enterprise.

The recently destroyed electric light plant at Silver Lake, N. Y., will be rebuilt, Putnam, Gay & Co., of Rochester, having the contract.

Thatcher Automatic Dumping Car Co., of New York City, has been incorporated in W. Va., capital, $2,000,000, for manufacturing and selling cars.

The Kirker & Bender Fire Escape Co. has been incorporated, at Louisville, Ky., to manufacture patented fire escapes. The capital stock is $100,000.

The Tuscaloosa Manufacturing Co., Cottondale, Ala., has lately put considerable additional machinery in its cotton mill, and will soon put in another engine, etc.

The Excelsior Manufacturing Company, of Chattanooga, Tenn., will erect a factory for the manufacture of a patent wood-shaving packing material, at a cost of $7,000.

The plant of the Trenton Foundry and Machine Works, Trenton, Tenn., has been sold to Ramsay, Owens & Co. They will enlarge the plant and operate it regularly.

The United States Wire Cable Co., at Schenectady, N. Y., has been incorporated, with a capital of $1,000,000, to manufacture and sell wire, wire rope, cables, conductors, etc.

The Oliver Aluminum Company, of New York, is putting up a plant in Jersey City, where it expects soon to extract pure aluminum from the clays of New Jersey at very low cost.

The McVey Galvanized and Corrugated Steel Mill, of Chicago, Ill., is to be torn down and moved to Muncie, Ind., where it will be run in connection with the Midland steel plant.

The city of Wheeling, W. Va., will remove its dumping station to a new location, and place considerable additional machinery. About $110,000 will be spent on the new location.

The Automatic Car and Air-brake Co., of Madison, Ill., has been formed, with capital stock of $10,000,000; incorporators, James B. Thomas, Murray Carleton and John P. Boogher.

The Buffalo Foundry Supply Company has bought a site in Buffalo (N. Y.) for one of the most complete factories for the manufacture of foundry facings in the world. They will employ 250 men.

Extensive enlargements are being made to the shops of the Janesville Machine Company, at Janesville, Wis. The capacity of the foundry has been doubled, and several smaller buildings have been erected.

The Cushman Iron Company, of Roanoke, Va., intends enlarging its plant very soon, as business is very brisk and the plant now is too small. The company will begin the manufacture of bicycles next year.

The LeClaire Steel Co., Belleville, Ill., has been incorporated, with a capital stock of $50,000, to manufacture nails, merchant iron, etc. The incorporators are James C. Waugh, C. W. Stanley, and W. M. Switzer.

It is stated that the Southern Malleable Iron Co., Chattanooga, Tenn., will enlarge its plant by the addition of the machinery of the Hinson Car Coupler Co., of Chicago, and will hereafter manufacture the Hinson coupler.

A new factory is to be built on the site of the Scotford Plant, which was burned at Kenosha, Wis., a few months ago. It will be used for the manufacture of tools and cars used by the David Clay Ballast Company.

The plans originally proposed for the new shops of the Gould Coupler Co. at the new town of Depew, near Buffalo, have been materially changed. Architect Geo. J. Metzger expects to have the new plan of specifications ready before Aug. 1.

J. E. Van Valkenberg and others will organize a stock company to erect electrical works in Chattanooga, Tenn. They have purchased the right to manufacture in Tennessee the lamps, batteries and motors of the Hubble Electric Light and Power Co.

Sweet's Metal Cross Tie Company has been incorporated at Los Angeles, Cal., with a capital of $1,000,000, for manufacturing and dealing in Sweet's steel safety cross ties and fastenings, locomotive cars and steamboats—operating iron and coal mines.

A. E. Drought, J. H. Dawe, M. Katz and others will apply for a charter for the Kissimmee (Fla.) Manufacturing, Improvement and Electric Light Co., having for its purpose to erect an electric light plant, iron foundry, etc. The capital stock is to be $15,000.

The Jones Sleeping Car Co., of Denver, has let the contract for the first of the buildings for its proposed new shops to J. H. Ross & Co., of Denver. The building is to be of brick, 40 x 70 ft. It is said that a contract for the machine shops, 100 x 250 ft., will be let this month.

Arrangements have been completed for the building of a Pintsch gas plant at Toledo, with a capacity of 400 cars, for the supply of Lake Shore equipment centering in Toledo. The Wabash and Cincinnati, Hamilton & Dayton cars will also take gas from the same plant.

The National Machinery Co., Tiffin, Ohio, has issued a new and enlarged catalogue of upsetting, forging and bending machinery that cannot fail to interest mechanics. The catalogue is finely printed and illustrated, and shows their nut and bolt machinery by cuts and description.

C. J. Jenne, William Carter and Charles E. Willey have incorporated the C. J. & W. Electric Co., at Louisville, Ky., to deal in and manufacture electric machines, etc. The capital stock is $10,000. Mr. Jenne is president; Mr. Carter, vice-president, and Mr. Willey, secretary and treasurer.

There is water-works agitation in Canton, O.; Alliston, Ont.; Sheldon, Ia.; Sharon Hill, Pa.; Woodstown, N. J.; Great Barrington, Mass; Ontario, Cal.; Allendale, S. C.; Greenville, Me.; Winthrop, Mass.; Pella, Ia.; Coleman, Tex.; Orange, Tex; Huntington, L. I.; Norfolk, Conn.; Petoskey, Mich.; North Manchester, Ind.

A deputation of Canadian Pacific officials, together with the city council and members of the Board of Trade of St. Thomas, Ont., on Tuesday last surveyed the eastern portion of the city with a view to selecting a site for a station, roundhouse and shops. No definite action was taken, but it is understood that the site for the new building was selected.

The main building of the new shops of the Shepard Bridge Works Co., of Havana, N. Y., is 210 x 60 ft., and will have a wing of ample proportions at right angles. The interior will be supplied with derricks, tram cars and other paraphernalia for handling iron, arranged with a view to convenience and expediency. It is understood that 100 hands will be employed in the new plant.

The Deane Steam Pump Co., 72 Cortlandt street, N. Y., has recently built and delivered two 1,000,000 gallon compound duplex pumps for Commodore Eldridge T. Gerry for his building at Broadway and Warren street, and a 1,500,000 gallon compound duplex pump for Henry Batterman, the dry goods dealer, Broadway, Brooklyn, E. D. They are at present building one 3,000,000 gallon compound duplex pump for Messrs. Stern Bros. for their dry goods establishment in Twenty-third street, and two 1,250,000 gallon compound duplex pumps for Solomon Loeb for his new building in Franklin street. The Deane Company report a busy season, having many large contracts on hand, and the prospects for the fall trade good. The town of Gravesend, L. I., has contracted with this company for a 5,000,000 gallon pumping engine, to be delivered and erected during the month of October, although it will not be called into active commission before early spring. The pumping engine will have a capacity of double the old pumps now in use, and will be amply large for the rapidly growing demands for water at this place for several years. The company has recently built and erected pumping engines for Woonsocket, R. I.; Waco, Texas; Salamanca, N. Y.; Watertown, Mass.; Portsmouth, N. H., and Lynchburg, Va.

Machinists' Supplies and Iron.

NEW YORK, August 6, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14.50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $14.25 to $15 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.75 to $13.50 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Antimony—The market is steady.

We quote Hallett's, 10¾c. to 10⅞c.; Cookson's, 13¾c. to 13⅞c.; and L. X., 12c. to 12¼c.

Lake Copper—The market remains unchanged. Holders are reserved in their offerings, and buyers are postponing their wants as 11¾c. is above their views. Casting Copper is held at 10¾c. to 11¼c.

Lead—No important business has been reported. The jobbing demand is being met at 4 10c.

Lard Oil—The market is quoted at 61c. for Prime City. Western on spot is quoted at 60c.

Spelter—The demand is quiet. It is quoted at 4.80c. for most brands on spot.

Tin—A depressed feeling prevails. The only business reported consists of 25 tons for August delivery at 20.77½c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—A few exp'd machinists accustomed to marine work. Apply to Bath Iron Works, Bath, Me.

Wanted—Several good molders. Morgan Iron Works, Spartanburg, S. C.

Wanted—Position as foreman molder; reference furnished. Address M., Hopedale, Mass.

Wanted—Agents in every shop for machinists' fine tools, sliding calipers, etc. E.G.Smith, Columbia, Pa.

Ass't mech. dftsman, exp'd in marine, stationary eng. work, desires situation. Box 46, AM MACH.

Wanted—Position as draftsman, by an apprenticed mechanic with tech. education and 2 years' exp. in drafting room; age, 23. Box 45, AM. MACH.

Mechanical eng. would represent large concerns on the road or manage N Y. office; first-class negotiator. Address Salesman, Box 3,141, N. Y.

Draftsman and designer of machine tools, general and special machinery, and tools for mfrs, desires a change. Box 38, AMERICAN MACHINIST.

Wanted—Foreman to take charge of machine shop in Canada, manufacturing stationary and marine engines; none but first-class exp'd man need apply to Box 49, AMERICAN MACHINIST.

Wanted—A pattern maker who is also a fair draftsman; must be bright, active and reliable. Address, stating references, age and wages expected. Joseph Reid, Oil City, Pa.

Wanted—Position as supt; will take entire works on contract if desired. Manufacturers wishing to reduce cost of production will find it to their advantage to correspond. Box 47, AMER. MACHINIST.

Wanted—Foreman to take charge of machine tools; must be a skilled machinist, experienced in handling men and familiar with modern tool methods; good wages; state experience and references. Hercules Iron Works, 502 Owings Building, Chicago.

Wanted—Situation by a man thoroughly competent to superintend large establishment; 23 years' experience in the best shops in the country on guns, sewing machines and typewriters. Address Box 43, AMERICAN MACHINIST.

Wanted—Tool keeper to take charge of tool room, and capable of making such small tools as are used about machine and boiler shops. Apply with reference to Valk & Murdoch Iron Works, Charleston, S. C.

Wanted—First-class man, who has had long experience in Corliss engine building; must be first-class draftsman and inspector, and able to figure on compound condensing plants. Address, giving exp., ref., and salary desired, Box 28, AM. MACH.

Wanted—An exp'd man capable of filling position as superintendent in factory employing 125 hands, manufacturing electric railway supplies; must be thoroughly posted on gear-cutting and must be a hustler. Address Box 40, AMER. MACHINIST.

Wanted—Mechanical superintendent as foreman for tempered steel specialty manufactory; must be thoroughly capable for production of interchangeable exact work; preferred with some experience of carriage business. Give age, salary expected, refs., and send photograph. Box 42, AM. MACHINIST.

Wanted—Position as sup't or gen'l foreman of machine shop. American, 42 yrs. old; 22 yrs. exp., which covers steam eng's, hydraulic elevators, mining mach'y & gen'l repairs; used to handling men to best advantage; up in mod. shop practice; best references. Address Box 48, AMERICAN MACHINIST.

Wanted—A first-class draftsman, with experience on latest practice Corliss engine work and heavy machinery; none other than quick and accurate workman and of good personal habits and character need apply; give experience, and state salary expected; also one quick and accurate tracer and assistant draftsman wanted at once. Address Henderson, care AMERICAN MACHINIST.

Wanted—Superintendent for one of the largest, most progressive and best known machine tool concerns in the United States; will have entire charge of works; none need apply except those now in similar position with one of the standard tool builders of the country; must be progressive, and in touch with the most modern shop practice. For the right man this is the opportunity of his life; much more back of it than can appear in an advertisement; all communications strictly confidential. Box 31, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d-hd lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Presses, Wire Form'g Mchy. Am. Tool Wks, Clev, O.

Sliding Gauges, etc. E. G. Smith, Columbia, Pa.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

George D. Slade, dealer in molding sand of all grades, Waterford, N. Y.

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From ⅛ oz. to 1000 lbs. Small Castings a Specialty. Light machinery wanted to build.
ONTARIO IRON WORKS
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Both hands to handle work. Double capacity over old plan.
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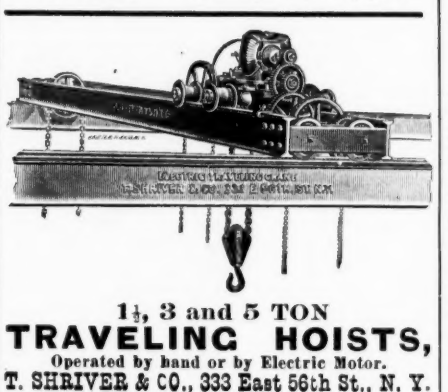
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MADE EASY
BY USING
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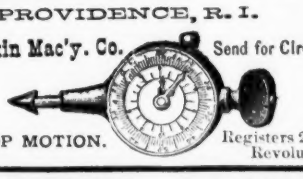
A. B. Pitkin Mac'y. Co. Send for Circular.

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MOFFET PORTABLE DRILL.
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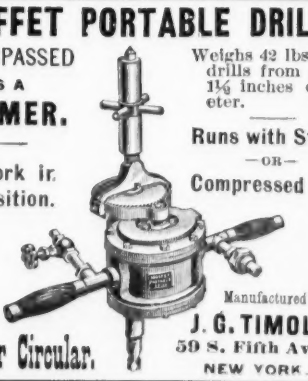
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Runs with Steam —OR— Compressed Air.
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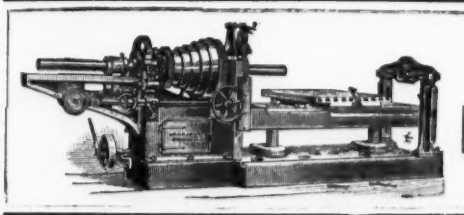
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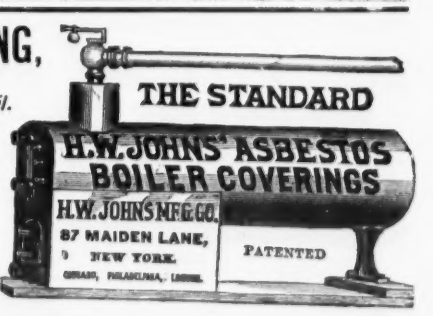

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✣ MISCELLANEOUS WANTS ✣

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For Sale, Cheap—Patent of grip pipe wrench. Address B. F. Chappell, Quarryville, Conn.

Wanted lists of fittings, etc.; specity., design & superv'n, etc., mach'y. C. Mantle, 598 E. 134th St., N.Y.

Wanted—A specialty to manufacture either heavy or light work. We have splendid facilities. Address "Manufacturers," Rockford, Ill.

Agency wanted—A young, energetic mechanical engineer wants to represent some good firms for Buffalo and surroundings. Box 44, care AM. MACH.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

Wanted—To sell the entire right of my universal bench vise; best testimonials from pattern makers and others. J. F. Emmert, Box 313, Waynesboro, Pa.

For Sale—One Empire steam pump, 5" suction 4" discharge; one 2 horse-power Taylor sweep machine; will take foot power screw cutting lathe in exchange. E. C. Knowlton, Sackett's Harbor, N. Y.

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1 15 in. x 6 ft. Blaisdel, " " " with Chuck. A1 condition.

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1 22 in. x 22 in. x 5 ft. Whitcomb. Good as new.

MISCELLANEOUS.

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1 Pratt & Whitney 6 Spindle Drill Press. A1 condition.
1 Garvin No. 4-4 Spindle Drill Press. " "
1 12 in. Gould & E. Crank Shaper. Good as new.
1 No. 3 Cincinnati Universal Miller, complete with Rack Cutting and Vertical Attachments and tot tools.
1 Ames Two Spindle Profiler, with Cutters. Good order.
1 No. 3 Pratt & Whitney Plain Screw Machine. " "
1 No. 2 " " Screw Machine, Automatic Chuck and Wire Feed. Good as new.
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10 ft. x 10 ft. x 16 ft. Planer.	1 Head.		
72 in. x 48 x 30 ft.	3 Heads.		
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36 in. x 38 in. x 8 ft. do	Powell A1.		
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25 in. x 24 in. x 6 ft. do	1 do		
22 in. x 21 in. x 5 ft. do	1 do		
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48 in. x 22 ft. do	do	do	do
42 in. x 17 ft. do	A1	do	do
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26 in. x 25 ft.	D. W. Pond Engine		do
32 in. x 12, 14, 16, 18 ft. Bed.	New	do	do
28 in. x 12, 14, 16, 18 ft. do	do	do	do
21 in. x 10, 12 ft. do	do	do	do
20 in. x 7½ & 8 ft. do	2d Hand	do	do
18 in. x 6, 7 & 8 ft. do	New & do	do	do
17 in. x 8 ft. do	do	do	do
16 in. x 6 & 8 ft. do	do	do	do
15 in. x 6 & 8 ft. do	do	do	do
14 in. x 6 ft. do	do	do	do

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20, 24, 26 & 30 in. Geared Shapers.
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78 in. swing,	9 ft.	between centers			Sellers
38 do	17 ft.	bed.	New		Fifield
30 do	14	do	do		do
27 do	16	do	do		
24 do	12	do	do		Fifield
24 do	12	do	do		Fitchburg
24 do	12	do	do		Flather
22 do	10	do	New Pattern		Fifield
22 do	12	do	do		do
22 do	12	do	New		Blaisdell
22 do	8	do	do		Flather
21 do	10	do	do		do
20 do	8	do	do		do
20 do	10	do	do		do
18 do	8	do	do		do
18 do	10	do	do		do
18 do	8	do	do		Blaisdell
18 do	16	do	do		do
16 do	6	do	do		Flather
16 do	6	do	do		Blaisdell
15 do	6	do	do		Flather
14 do	6	do	do		do
14 do	6	do	do		Blaisdell
12 do	6	do	do		do

PLANERS.

42 in. wide,	42 in.	high,	12 ft.	long, 2 heads	Gleason
36 do	36	do	8	do	Pease
30 do	30	do	8	do	do
30 do	30	do	8	do	Whitcomb
30 do	30	do	8	do	Flather
26 do	26	do	6	do	do
24 do	24	do	6	do	do
24 do	24	do	6	do	Whitcomb
22 do	22	do	5	do	do
22 do	22	do	6	do	Flather

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" "	24 in. x 12 ft., Old Style, Low Price,	Fair order.
" "	24 in. x 12 ft., C'p'd Rest, Putnam.	Good order.
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" "	32 in. x 12 ft., " "	"
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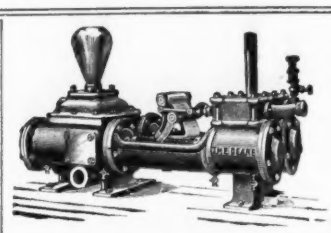

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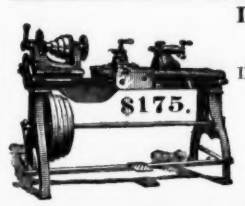

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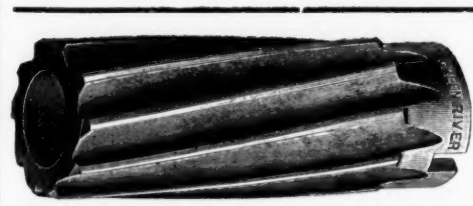

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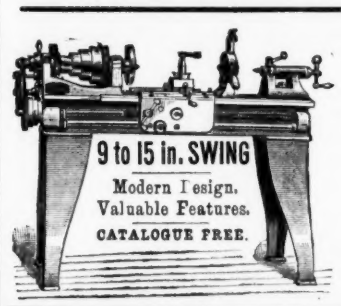

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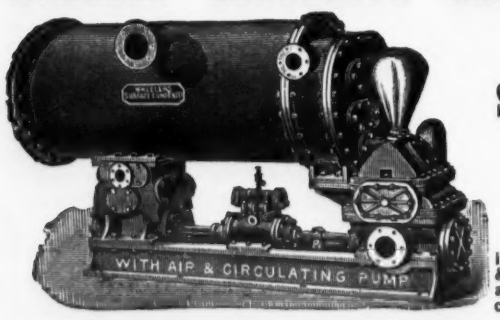

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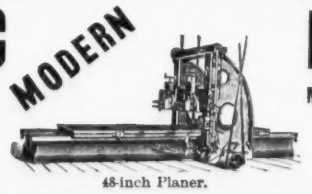
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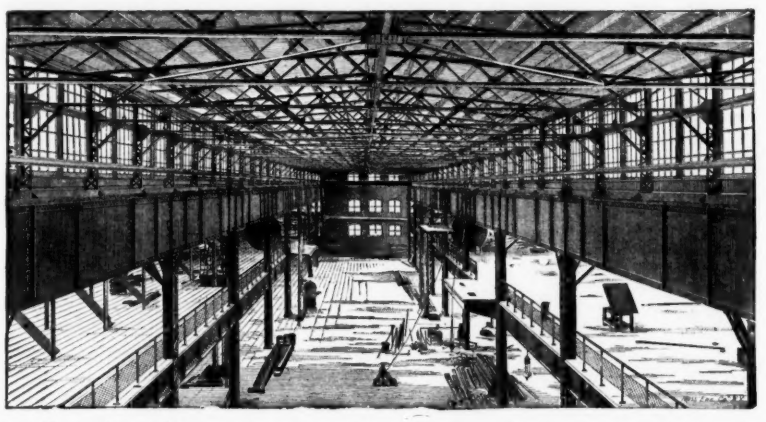

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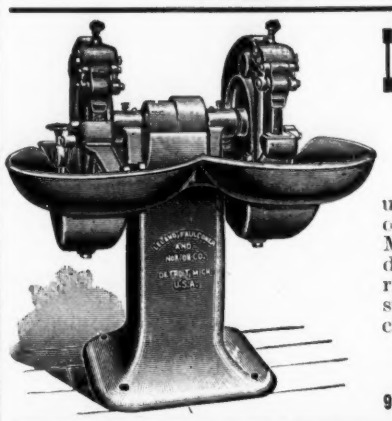

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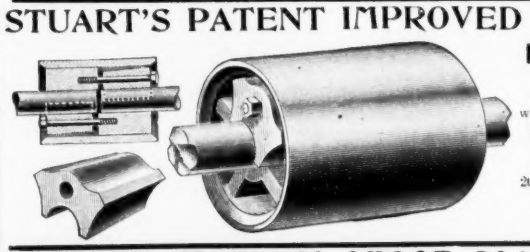

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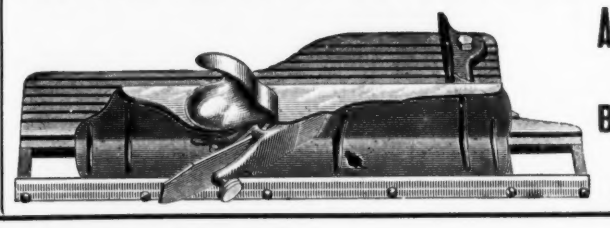

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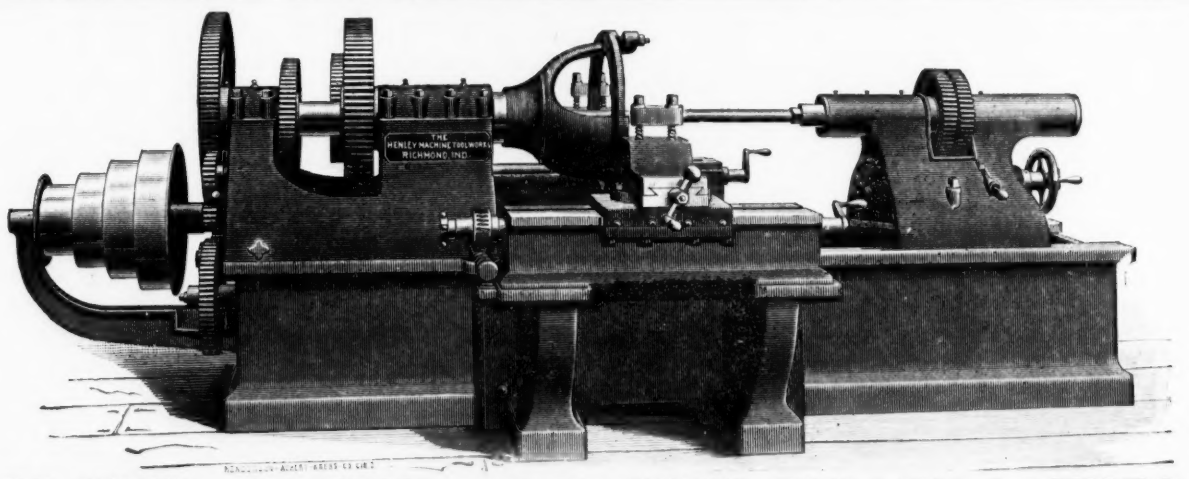

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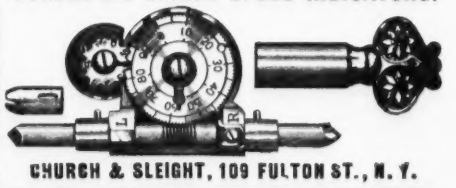

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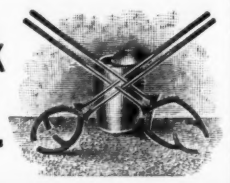
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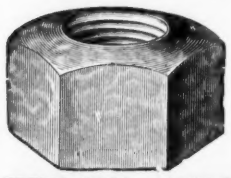
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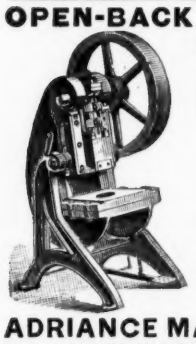
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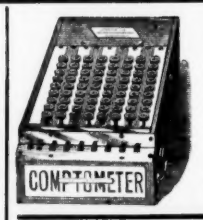

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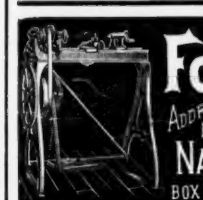
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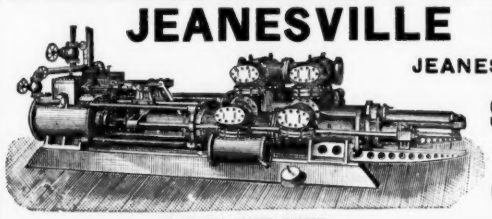
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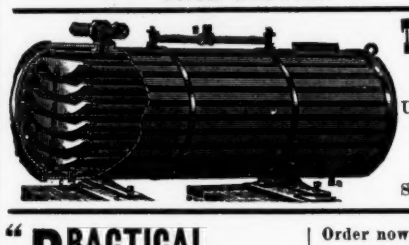
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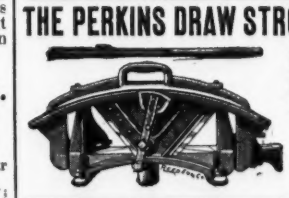
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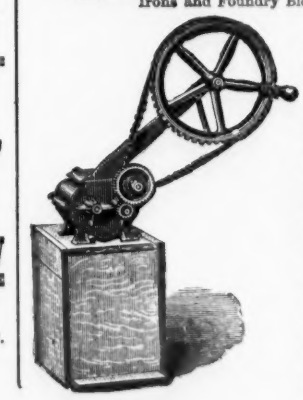
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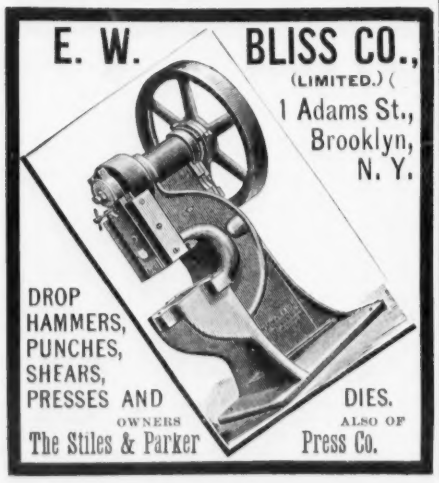
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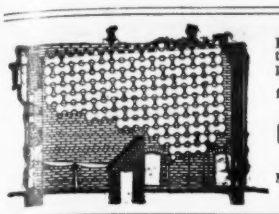

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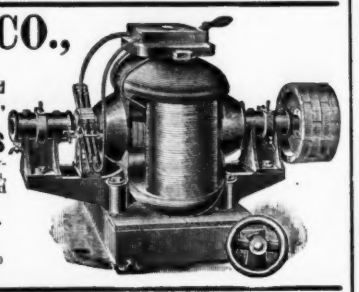

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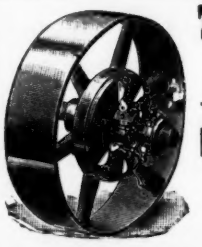

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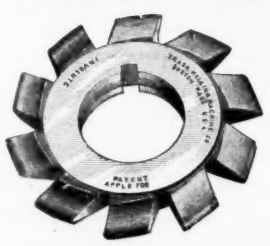

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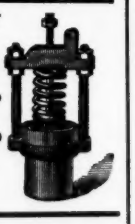

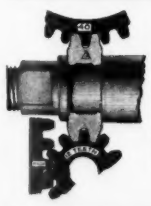

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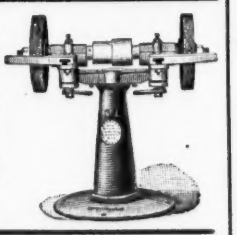

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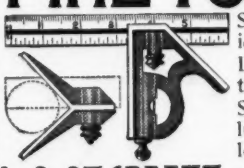

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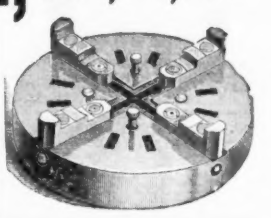
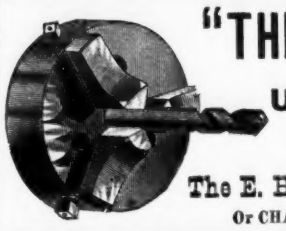
36 "	40 "





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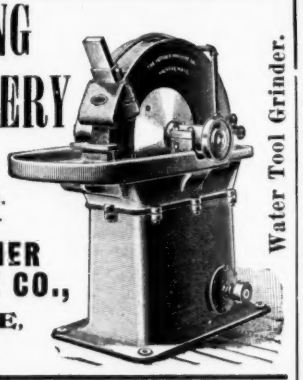

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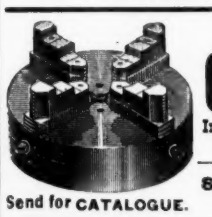

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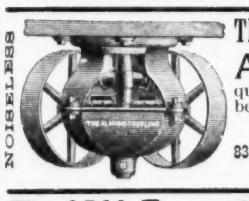

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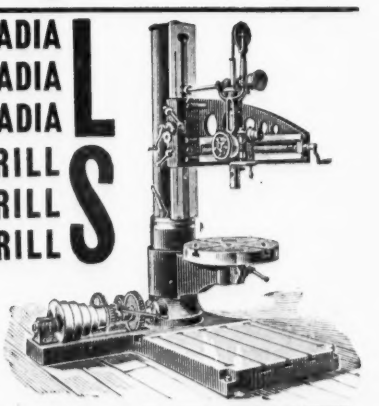

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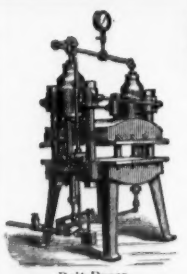

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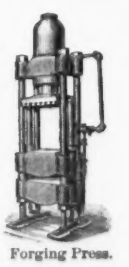

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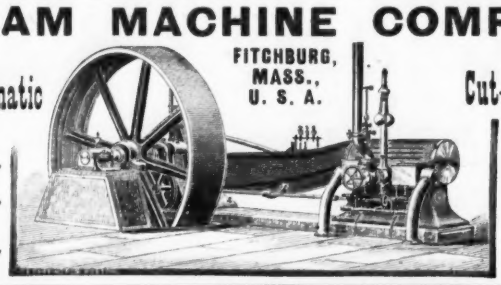

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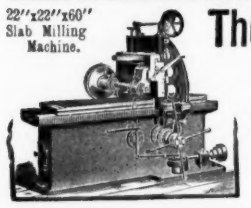

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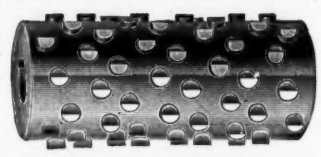

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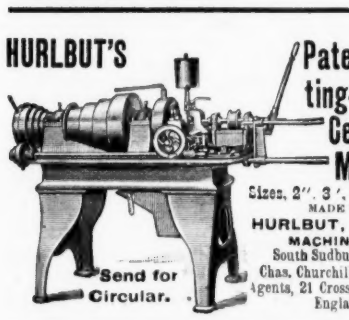

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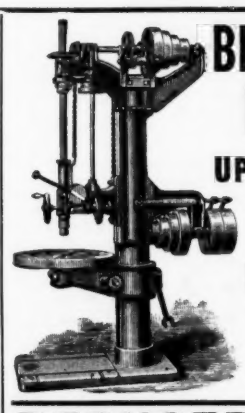

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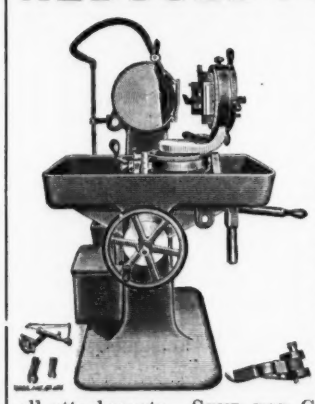

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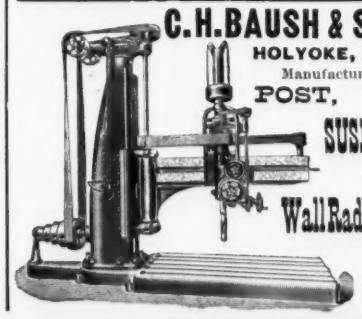

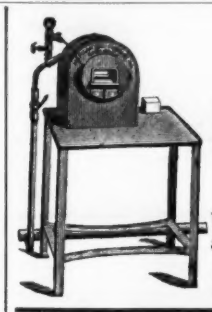

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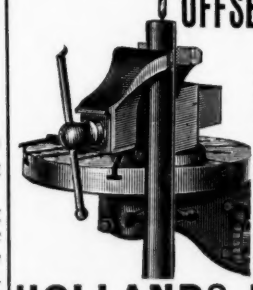

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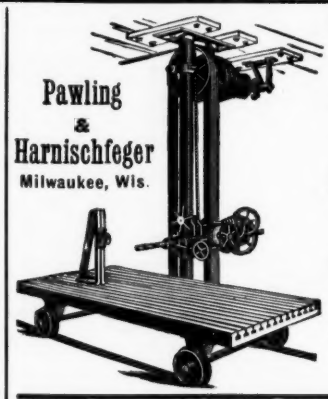

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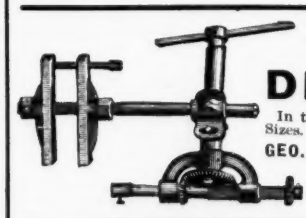

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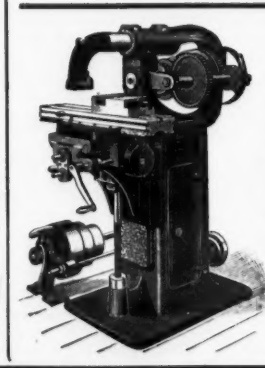

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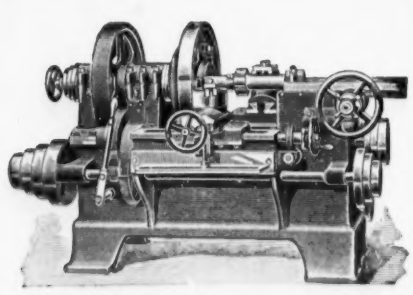

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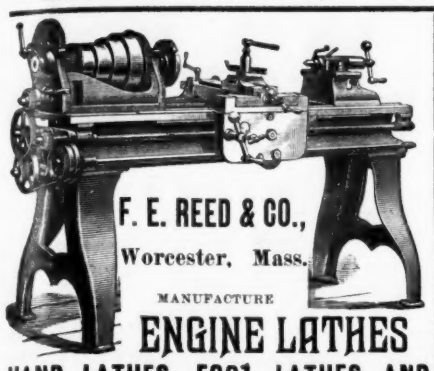

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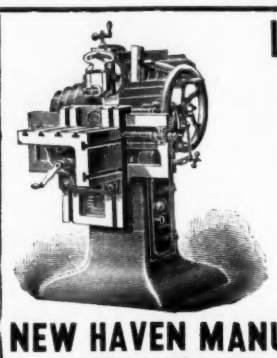

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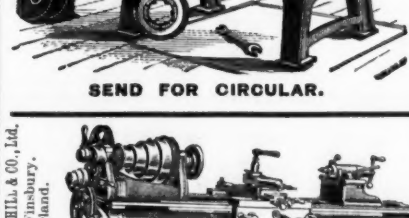

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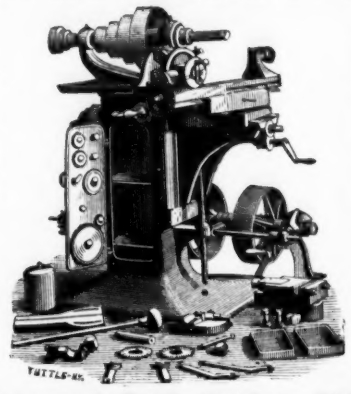

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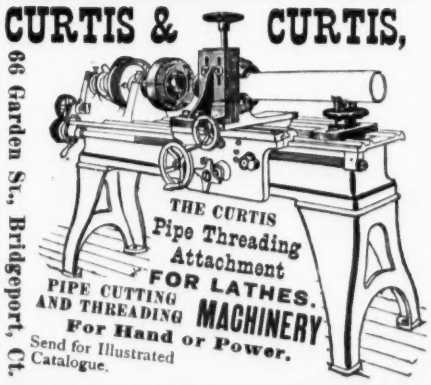

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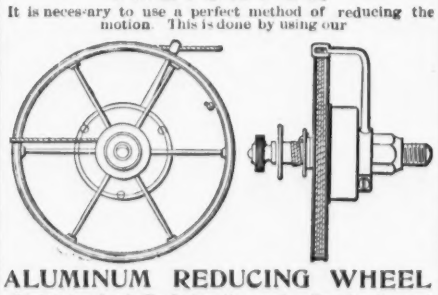

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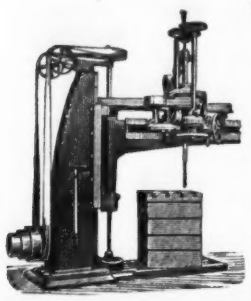

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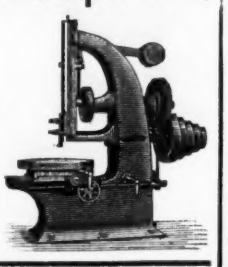

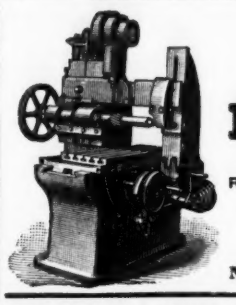

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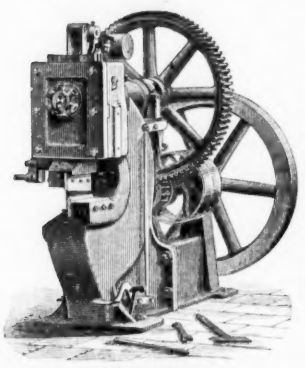

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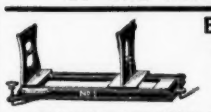

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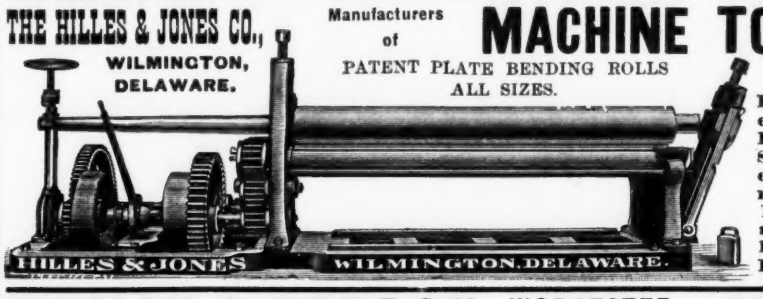

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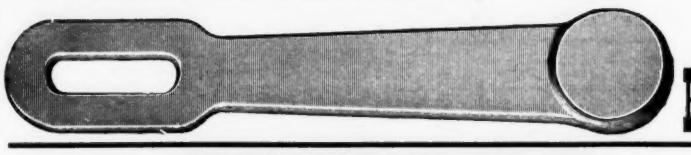

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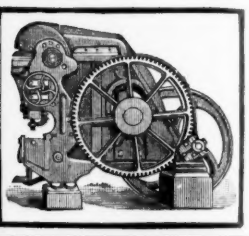

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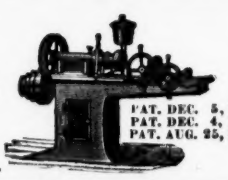

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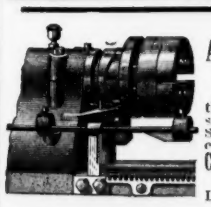

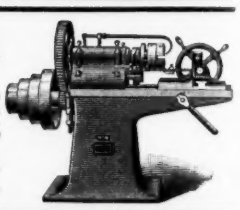

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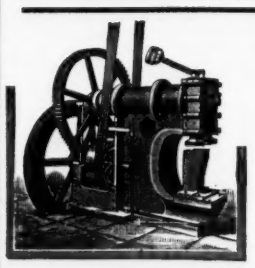

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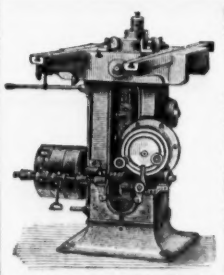

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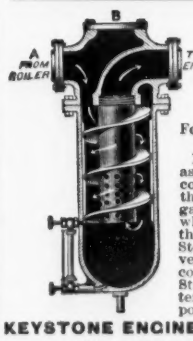

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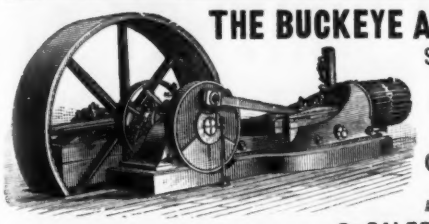

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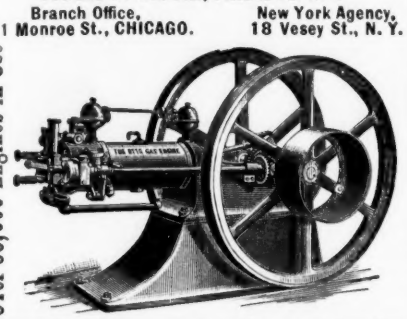

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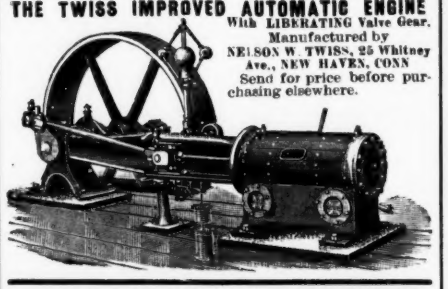

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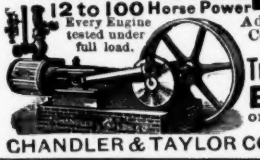

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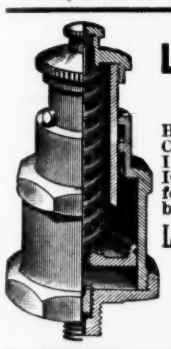

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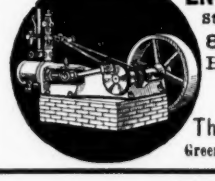

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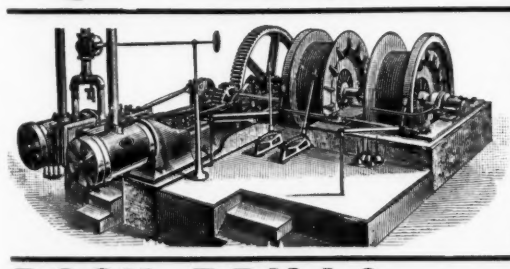

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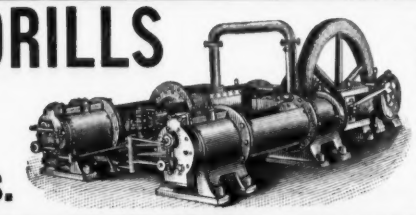

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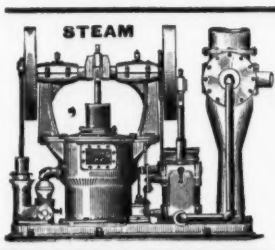

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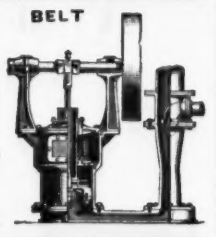

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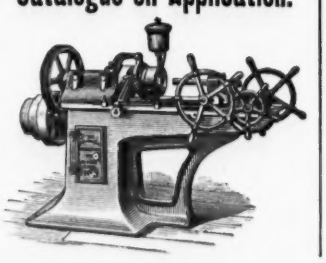

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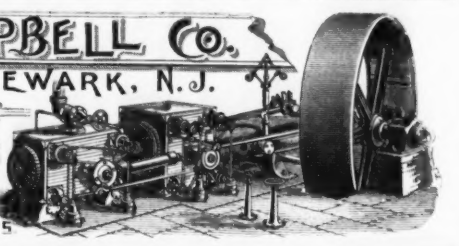

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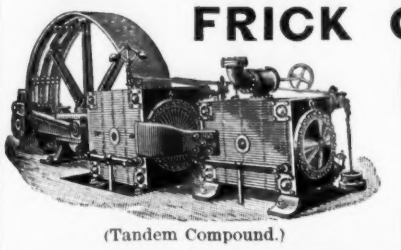

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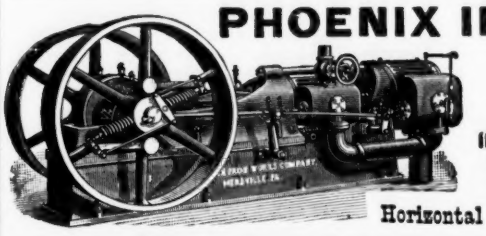

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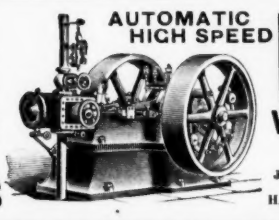

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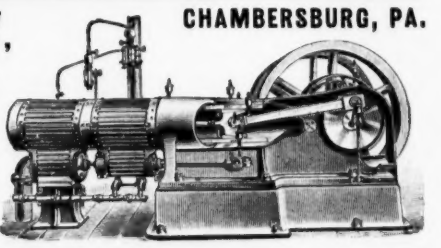

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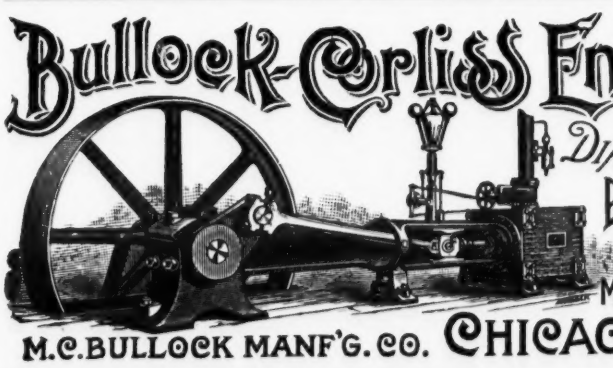

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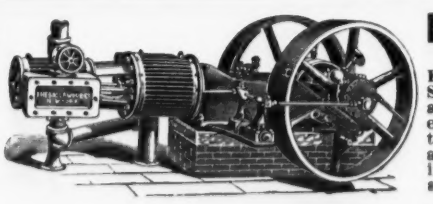

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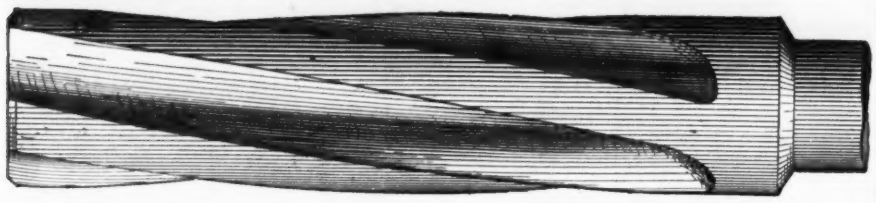

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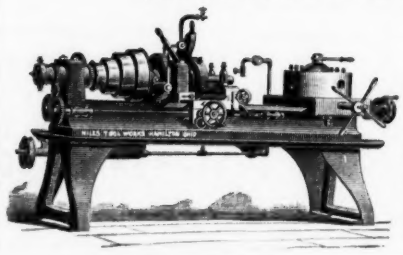

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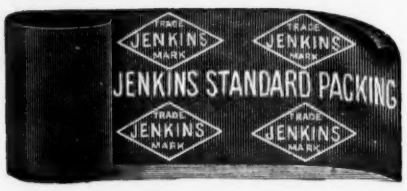

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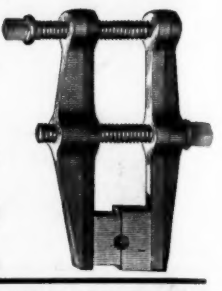

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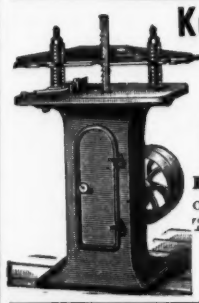

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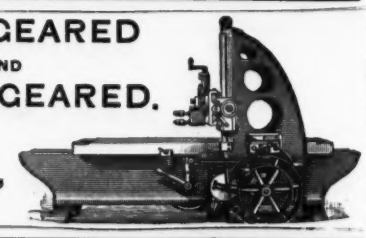

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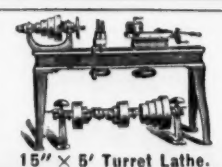
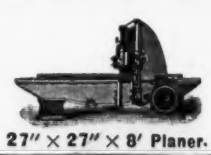


15″ × 5′ Turret Lathe.



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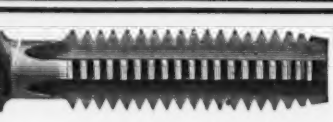

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tracks spelled "tiger" to the hunter as plainly as does type to us to day, and there is no question but the type was movable. The Nautilus shows us a boat with sails and self-contained power; a little ingenuity will leave man without an original idea. We are sure the diamond drill was used on the pyramids, and if the form of these structures gave the idea of the straight line engine, the writer fails to see why any less praise should be given its designer—is there less praise to be given Weston for his pulley block because the Chinese windlass showed the idea in a non commercial form?

It takes more than words to prove America's supremacy in mechanical arts, and to try to prove it by the liberal use of trade catalogues is, in the opinion of the writer, abortive, and it seems strange that anybody who believes in such supremacy should go out of the country to select a water-wheel for an American enterprise, when the writer knows that an American wheel is being exported to Europe on account of its superior work, in the face of the fact that cheaper wheels are to be obtained there; it only goes to show that the American engineer will select the best in his opinion, no matter where it is found.

Boasting is not to be encouraged, but it really seems that in certain lines America has a right to be proud. Stevens made the T-rail, which form seems to be perfect; Pullman made riding on it a pleasure, and Westinghouse probably has saved more lives than all the doctors of the past twenty years by his brake, but in naming these men we do not detract from the name of John Stevenson. In general, the writer has found Americans ready to bow to intellect, and credit it wherever it belongs.

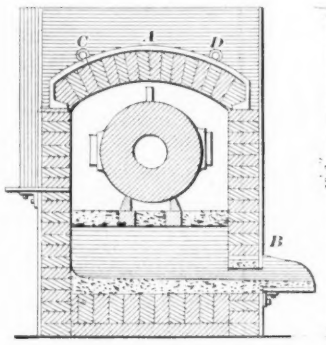


Fig. 3.

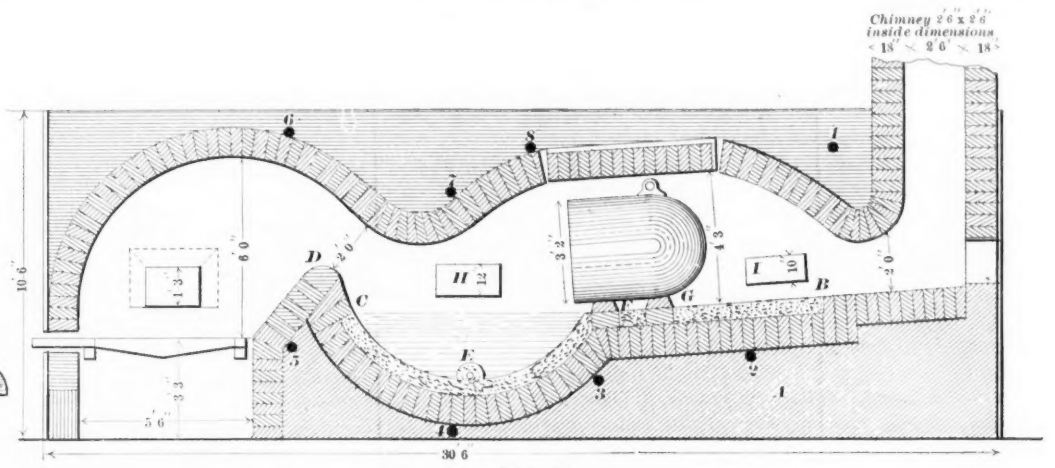


Fig. 2.

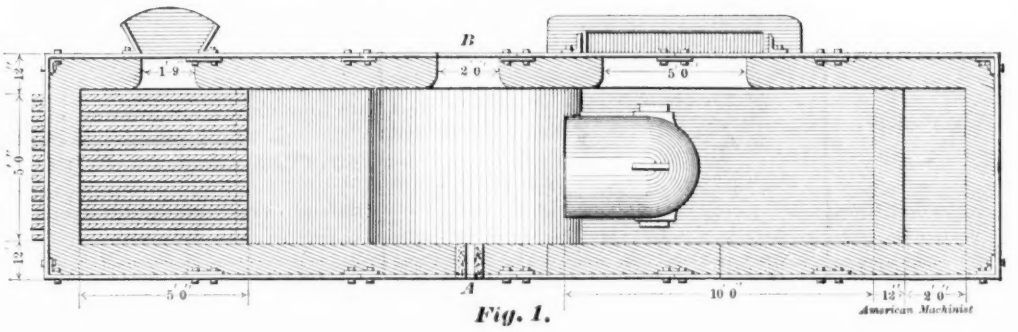


Fig. 1.

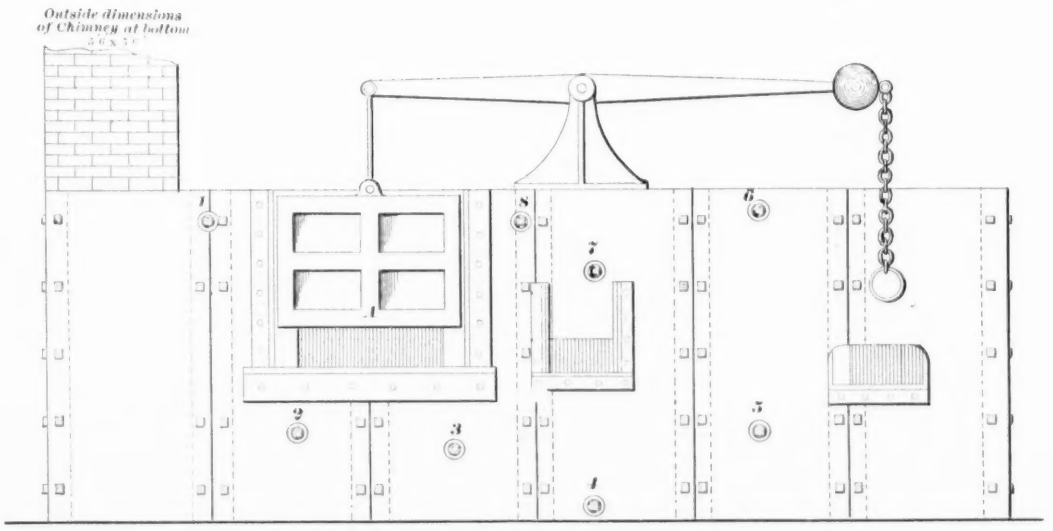


Fig. 4.

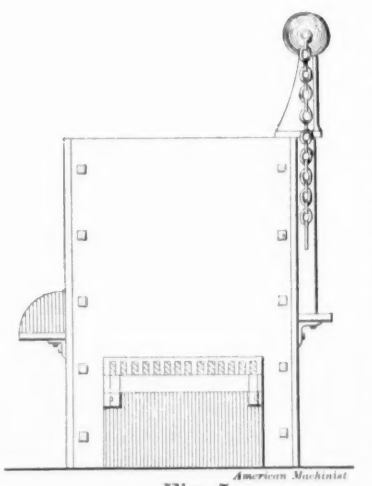


Fig. 5.

MELTING CAST IRON IN REVERBERATORY FURNACES.

Melting Cast-iron in Reverberatory Furnaces.

BY S. BOLLAND.

Reverberatory, or as they are more frequently called, "wind or air furnaces," to distinguish them from those worked with compressed air or blast, are not as commonly used for general purposes now as they were formerly, for manifest reasons, some of which it would, perhaps, be well to inquire into.

In the first place it is claimed that they are too expensive in their working, requiring, as they do, more than twice the amount of fuel that is needed in the cupola for the production of good hot iron; but an extensive practice has convinced me that even such considerations would have been overlooked on particular occasions, if there had been a good reverberatory furnace in the shop.

Too frequently castings are needed which, if common justice was done to all parties concerned, ought to have been cast from the reverberatory furnace, and in the, sometimes, oft-repeated effort to produce iron of the desired homogeneousness in the cupola, the cost of production, in the end, has been very far in excess of what it would have been had the proper furnace for the job been on hand.

Another of the prime causes for this discontinuance is the great lack of knowledge manifested in their construction and management, owing to which failures have attended the efforts of quite a number of founders who have endeavored to establish their use, and they have been forced to abandon the enterprise and fall back, disappointed, to the cupola again.

This should not be the case, nor need there be any such giving up; the business can be learned, like any other, by hard application and industry, and no better incentive to this could be adduced than to inform all such as have failed in learning the art, that throughout the whole of Europe the reverberatory is as common as the cupola furnace is here.

Do not understand me as urging their general adoption in place of the cupola; in view of the latter's great utility such a proposition would be preposterous in the extreme; but I do maintain that if they were built and held in readiness for emergencies, which are constantly occurring, it would reveal a greater wisdom on the part of our leading founders.

It cannot be denied that the reverberatory furnace will yield a purer metal than is possible for the cupola to do, simply because it is melted separate from the fuel, and consequently cannot absorb its impurities; whilst on the other hand the iron in the cupola is charged in direct contact with the fuel, with the consequent result of being more or less impregnated with its impurities; this fact is incontrovertible, and speaks volumes in favor of the reverberatory, when absolutely clean iron is the desideratum.

Iron melted in the reverberatory furnace loses a portion of its oxygen during the process. This tends to harden by converting *graphitic* into *combined carbon;* hence the eminent adaptability of these furnaces for the production of iron suitable for guns, hydraulic cylinders, rams, heavy rolls, etc., as any degree of homogeneousness can be obtained by polling the molten iron in the reservoir after it has all melted, and at the same time allowing the full force of the flame to play upon its surface until the iron, by dipping test, shows the desired texture.

One great advantage claimed by the workers in malleable iron is, that iron melted in the reverberatory furnace anneals at a heat very much lower than would be required for iron melted in the cupola; this will in some measure compensate for the extra cost of melting in the former.

For the reduction of unwieldy masses of scrap iron, this class of furnace is indispensable, as any amount of this apparent drug can be reduced into good fluid iron with the greatest ease.

For the benefit of all such as are ignorant of the principles which govern the art of melting in these furnaces, it is needful to say that in all cases where it is desired to melt metals out of contact with the solid fuel, special combustion chambers or fireplaces must be provided, the metal being melted by the body of flame and heated gas acting upon its surface as it lays on the bed of the furnace.

To accomplish this effectively, the flame must be made to reverberate from the low vaulted roof of the furnace downwards, and the form of the roof associated with the velocity of the flame will determine what part, or parts, of the bed will receive the full force of the heat current.

This fact gives rise to numerous opinions as to the correct form to be given the inside of a reverberatory furnace for obtaining the maximum of efficiency, some favoring the method of placing the charge behind the bridge wall; others again maintain that the chimney end is the best for charging, because it is generally allowed to be the hottest; but however much they may vary in construction, the principles which govern, as noted above, are about the same.

The furnace represented by the illustrations accompanying this article is a very good one for general work, and very suitable for reducing or melting heavy lumps which would otherwise have to be cut up into smaller pieces before it would be practicable to melt them in the cupola.

The chief points in the representations have their dimensions figured; this will aid in arriving at a correct estimate of the proportions of the furnace shown. Its outside dimensions, exclusive of plates, are 30 feet 6 inches long and 7 feet wide. The whole structure is incased in wrought-iron plates joined together, as shown in plan, Fig. 1, and again by broken lines at Fig. 4.

The corners are held together with angle irons, and the principal anchors are those shown at Fig. 4, and marked from 1 to 8 respectively. These "chief" anchor bolts reach from one side to the other, passing through the structure at such places as are

best calculated to bind the whole firmly together, and, at the same time, are clear of all working parts of the furnace, as will be observed by referring to Fig. 2, where the position of each bolt is shown at figures corresponding to those marked on the side elevation, Fig. 4.

The amount of strain which this furnace is called upon to bear, owing to the intense heat and pressure to which it is subjected periodically, makes it imperative that not only the walls, but the foundation also, should be as substantially built as possible.

The foundation *A*, Fig. 2, can be built up solid of common material, up to the line of fire-brick, and in such form as will allow the fire-bricks when set thereon to incline from the chimney to the reservoir in a downward direction, as shown at Fig. 2, and it will be seen that all those from *B* to *C* must be kept six inches below what it is intended shall be bottom of the furnace after the sand bed has been formed upon it.

The bridge wall *D*, Fig. 2, must, in this case, be not less than 2 feet 3 inches from the face of the grate bars, and like the sides, roof and fireplace, must be built with the most refractory kind of fire-bricks.

The fireplace must in all cases be built the full width of the furnace to commence with; should it be thought desirable to contract its dimensions subsequently, the task will be an easy one.

The roof, throughout its entire length, is an arched one, and, as before stated, must be of fire-brick; whatever filling is done above the fire-brick arches can be of commoner material.

The chimney for such a furnace would need to be from 30 to 40 feet in height, surmounted with a damper, so arranged as to be easily controlled from the bottom; this is an important feature, as the draught is regulated altogether by the damper. It is hardly necessary to say that a chimney of this sort must be built with an inside course of fire bricks, and no matter what form the outlet from the furnace may be, it is best to build the chimney square.

The methods adopted for binding these chimneys are various, but as they are well understood by all masons accustomed to this class of work, it will not be necessary to describe them here. As to their dimensions, it is a common rule to have the inside area equal that of the air space in the grate, but these things can only be determined by actual experience and practice. I have seen good melting done in reverberatory furnaces whose chimneys, in some instances, were much smaller than the rule allows, and again, in other ins ances, when the chimney's area has been in excess of the air space in the grate, the melting has been all that could be desired. I therefore conclude that it would be the wisest, in all cases, to have the area of the chimney somewhat in excess of the fireplace, as in any case the damper will regulate the draught with certainty when the height is sufficient.

A very excellent mode of building chimneys is to have them as a separate structure, resting on a sole plate supported by four columns; this gives opportunity for making a connection with the furnace or furnaces from any direction which may be chosen.

There are two kinds of charging doors shown; the one at *A*, Fig. 4, is on the side, and covers a hole 5 feet by 4 feet, through which the iron, heavy and light, is conveyed when the charging is all done from the side aperture; the other is seen on the top of the furnace at *A*, Fig. 3, and covers a hole as wide as the furnace, 6 feet in length.

In all cases when the iron to be charged is heavy, the latter method is the most convenient. As seen, the doors are lined with fire-bricks.

The manner of building a furnace, here shown, admits of easy access to any part for repairs, for as all the connections are made with bolts (not rivets) one or more of the plates can be detached at the place where it is needed for making alterations or repairs.

Fuel is the all important factor for producing hot iron in reverberatory furnaces, as it is also in cupolas, and although numerous tests have been made with coke, hard coal, anthracite and charcoal, none seem to work so well as the soft bituminous coal of the non caking kind; it is the only fuel upon which the utmost confidence can be placed.

The importance of a good draught in these furnaces will suggest itself to the least observant, but it must be remembered that this draught will draw cold as well as hot air through the stock if there are openings left at any point for its ingress; this bad feature is to be avoided by all possible means, and this can only be done by incessant watching of the fire, always endeavoring to keep a full grate of live coal, and when clinkering must be done, let it be done quickly and well, and avoid making holes in the fire, through which cold air can rush into the furnace.

The inrush of cold air is to be strictly guarded against from whatever cause; for, independent of the dangerous tendency towards chilling the furnace, there is a possibility of the chemical nature of the iron being changed by its admission.

When the draught is strong enough to force the flame with a velocity sufficient to melt the iron quickly and hot, it need not be urged any more.

By referring to Fig. 2 it will be seen just how much of the bottom needs to be made up with sand; it starts on the bed at *B*, and continues down and around the reservoir to *C* If this bottom be well made with a preparation composed of eight parts fire sand, and one each of clay and ground coke, it should last for ten heats, providing it receives from one to two hours good firing before the first charge is piled in.

The breast seen at *A*, Fig. 1, *E*, Fig. 2, and *B*, Fig. 3, can be made after the manner suitable for a large cupola, but as the hole must be stopped until the tap is made, pains must be taken to fill the cavity all through its length with fire sand mixed with a small portion of coal dust; this can be easily withdrawn, as it will not cake together when it becomes hot. Before tapping be sure and close the damper.

For charging purposes it is advisable to allow plenty of room at the doorways; especially is this the case when all must be charged through the side. The first layer of pigs must be set lengthwise with the furnace, a little apart, the following layers in opposite direction, but leaving spaces between each pig for the free passage of the flame; in fact, open charging is to be observed, no matter of what nature the pig or scrap may be.

When the pieces to be melted are of more than ordinary magnitude, it is then in order to have an open top through which to lower them down with the crane; the cover for such an opening is shown in end section at *A*, Fig. 3, being simply a segment of the circle corresponding to the arch of the roof at that point, with internal flanges for carrying a course of fire-bricks built in on end; the rings *C* and *D* are for lifting the cover on and off with the crane.

The object shown as resting on the bottom represents a U. S. 13-inch mortar, weighing about 17,000 pounds. Preparation is made to sustain this weight clear of the bed, by setting fire-bricks on the bottom, to finish level with the bed when it is formed, on which to rest other blocks for carrying the load; by this means the flame can play all around the piece, and a speedy reduction of the mass ensues, if all is working right.

It will be noticed that considerable space behind remains unoccupied, all of which can be utilized if more iron than is contained in the mortar be needed; for, as before stated, this is the hottest part of the furnace.

All the iron required should be charged at the first, as it is not advisable to attempt the reduction of any additional stock immediately after the heat is down; such attempts are attended with disaster oftener than otherwise, because the furnace cools off considerably by the admission of *cold iron* and *cold air*, making it next to impossible to melt the second charge before the iron first melted becomes cold and useless.

The hole shown at *B*, Fig. 1, and at *H*, Fig. 2, is the puddling hole, and, as will be noticed, is directly over the reservoir. It is through this hole that the dipping is done for testing purposes; the skimming is effected through this hole also. It is very important that the molten iron be kept clean, as any accumulation of dirt or scum upon its surface acts like a shield, and interferes with the direct action of the flame upon its surface; this, of course, is as good as so much heat lost.

Another very important operation which is readily accomplished by means of the puddling hole, is the boiling of the metal, a process which becomes absolutely necessary when opposite grades of iron are to be mixed together, out of which it is desired to obtain a thorough blending of the whole; this is done by thrusting down into the molten iron one or more green saplings. This, of course, creates a violent ebullition throughout the mass, and usually effects the desired result, but this, as well as the other operations, must be done with the utmost dispatch, otherwise cold air will rush into the furnace in sufficient quantity to neutralize every good effect which should accrue from these several important agencies.

Another hole is seen at *I*, Fig. 2, which enables the melter to take an occasional glimpse into the interior of the furnace, and being directly in range with the bed, he can materially accelerate the process of melting by separating such pieces as are welding together, as also by breaking up the more refractory ones; this hastens melting by increasing the surface upon which the flame can more effectually play.

The old saying, "that a stitch in time saves nine," applies with more than ordinary force to the management of these furnaces. A careful examination after each heat will reveal small and apparently insignificant faults. If these are at once remedied, these furnaces will not only last longer in good condition, but, as a natural consequence of their superior efficiency, will also melt hotter and better iron.

LETTERS FROM PRACTICAL MEN.

Inertia and Momentum—A Word Wanted.

Editor American Machinist:

In your editorial of the AMERICAN MACHINIST of this date, "A Word Wanted," you express a desire for a term which will express quantitatively the resistance of inert bodies to being put in motion. There are already two such terms well known to students of mechanics, viz.: 1, weight; 2, mass or weight divided by 32.2, the value of g at the earth's surface. Suppose we have a pound of metal resting on the surface of the earth, what is the resistance to its being put in motion vertically upwards at a very slow velocity? The answer, of course, is its weight, one pound. Suppose it is suspended from an overhead support by a long cord, or resting on frictionless balls on a frictionless track, what is its resistance to being put in motion horizontally? The answer is that it will depend on the velocity of the motion. The quantity of energy stored in it when in motion is equal to $\frac{1}{2} m v^2 = \frac{1}{64}$ weight $\times$ square of velocity in feet per second. If the velocity of the body is infinitely small it will require only an infinitesimally small expe diture of energy to put the body in motion. A 10,000-ton vessel which requires 20,000 horse-power of engine to keep it moving through the water at a speed of say 22 miles an hour can be towed about in the river by a small tugboat. It is evident, therefore, that no single term can express quantitatively the resistance of bodies to being put in motion which will give any clearer ideas of the subject than the two very satisfactory terms we now have—mass and weight.

The need for the new term, which you say has been realized by many of those who have attempted to master the theory of dynamics, is not felt to any considerable extent by those who have not merely attempted, but actually mastered it. It is not felt by students of mechanics who read modern text-books on the subject, in which rigid definitions are given to the terms used. Your correspondent has probably been befogged by reading some of the worst of the older writers on mechanics, or their copyists, who are badly mixed in their definitions, otherwise he would not say that a body in motion contains a force, nor that the "force" is called momentum; nor use such inexact expressions as "momentum is simply inertia at one end of the line," "momentum is inertia," etc.

Momentum, as defined by Rankine, is the product of the mass of a body into its velocity, or $m v$ or $\frac{W}{g} v$; but the term is now falling into disuse, as the word "energy," expressing the amount of work stored up in a moving body, or its capacity to perform work, represented by $\frac{1}{2} m v^2$, is more useful for ordinary purposes, such as expressing the energy in a moving fly wheel, or in a cannon-ball in foot pounds or foot tons. As this term is rightly becoming disused, there is surely no use for the invention of a new term for "inertia at the other end of the line," whatever that expression may mean.

CRITIC.

Editor American Machinist:

In commenting on the communication of an engineer in your issue of July 28th, regarding the importance of more accurate knowledge of the laws governing the inertia of bodies than we now possess, you correctly state: "What seems to be wanted is a term which will express quantitatively the resistance of inert bodies to being put in motion."

There are few subjects in the domain of physics in a more unsatisfactory condition than that of inertia. It appears to be as much a perplexity to the physicist as it is an obstacle to the engineer.

Innumerable instances are cited of the effect of inertia, but we are given little information by which we can determine quantitatively the effect.

The subject will always be a perplexing one, owing to the seeming impossibility of determining the amount of distortion which takes place in a body when a force is applied to move it, and which distortion will vary with the nature of the substance.

The force which distorts a body does not operate to move it. This appears paradoxical, but it is nevertheless true.

When force is applied to a body there is always a portion besides that which causes the distortion which operates to move the body, but the fact remains that a given force cannot be absorbed in the distortion of a body and in giving it movement at the same time.

No body moves from a state of rest instantaneously with the application of the moving force, but it always acquires its motion by degrees. The force requires to become diffused through the mass; that is, each molecule must feel the effect of the force applied before movement can begin.

With very elastic bodies considerable distortion of a part of the mass may occur before the whole acquires movement, in which case the body will appear to have a different amount of inertia than in the case of another body of the same weight and of different elasticity.

This illustrates an instance in which, as your correspondent says, "inertia is not necessarily momentum."

According to the principle of momentum, when a force is applied to move two bodies of different weights in opposite directions they will begin their movement at the same instant, but will acquire velocity according to their respective masses; but Dr. Anderson observed that the mark made on a parapet by the discharge of a disappearing gun was sharply defined, and coincided exactly with the muzzle when the gun was fired. He argued from that fact that the projectile must have left the muzzle before the gun began its recoil; that is, the moving force had ceased to act when the gun began its recoil movement. This seems to substantiate the position maintained by many regarding the inertia of bodies—that the moving force is required to become diffused through the body before movement begins, and that time is a necessary factor in the determination of the inertia of bodies.

Those who have been engaged in designing machines having parts which were re-

quired to be alternately and rapidly put in motion and brought to rest have experienced the practical difficulty that inertia occasions. They understand the importance of having those parts as light as practicable, and, in counterbalancing them, to do so by means of springs and not by weights. Increasing the weight of a moving body increases both its inertia at the beginning and the momentum at the end of the movement.

I. MCKIM CHASE.

Editor American Machinist:

Your correspondent who wishes a new word coined to distinguish the inertia which opposes motion, and that which opposes a cessation of motion, has evidently not studied the meanings of dynamic terms, otherwise he should not have met with any difficulty. He says, "Bodies are inert. Being stationary, power is required to move them. Being in motion, power is required to stop them." . . . He should have used the word "force" in place of "power." Furthermore, the word "momentum" is no longer used in the sense in which he uses it, "energy" being put in its place, and the energy of a moving body is not its inertia. Inertia is the resistance experienced in changing the direction or the rate of motion, and may be expressed in pounds. Energy is the amount of work absorbed while the body was put in motion, and is expressed in terms of foot-pounds. Then, again, motion is a relative concept. A thing may be at rest in relation to one basis of observation and at the same time moving in relation to another basis. The same force that imparts motion in relation to one basis may tend to stop motion in relation to another basis. Dynamics cannot recognize even a specific difference between rest and motion, and a careful study of the precise meaning of the dynamic terms now generally accepted by authorities will probably convince your correspondent that the vocabulary is as complete as the present state of the science of dynamics requires. HUGO BILGRAM.

Philadelphia.

Editor American Machinist:

In the matter of your editorial, "A Word Wanted" I have made use of "fixidity," a word almost obsolete at present, but one, it seems to me, quite applicable. Wherever I have used it in instruction it has been at once understood by my students, the majority of whom are not up in the higher word usages and practices. I have also adopted it in connection with inertia in the book matter I have been preparing.

New York. WM. H. WEIGHTMAN.

The "Old Man" Goes to the Sea-shore.

Editor American Machinist:

I have been considerably interested in Jack Loftus, who manipulates the sixty-inch lathe in the lower shop. Not that there is anything particularly uncommon about Loftus, except when anything occurs that disturbs the harmony of the machinery for a few minutes, instead of folding his arms and searching for a soft place to lean against, he goes where the trouble is located and helps get things in motion again, or else he uses a piece of waste cleaning off the soiled spots on his lathe.

Then, too, I have noticed that when one of the cubs gets puzzled as to the best method to employ on some particular job with which he is not familiar, and the foreman is not near by, he quietly goes to the cub, their heads get together, Jack makes a few gestures with his arms, the cub brightens up and goes about his work, while Jack gets back to his big lathe in such a didn't-miss-you manner that it is hard to realize that he and the cub ever saw each other.

Then at the noon hour when most of the boys are flippantly roasting each other and bolting their lunches, Jack puts his meal out of sight with deliberation and enjoyment, and is debating something with other shopmates.

While he has some decided opinions of his own, too, he carefully listens to those of others, and gives and takes in argument with the same deliberation and pleasure that he masticates his food.

But I have noticed a new wrinkle in Jack during the past four months and mentioned it to Brailey, the foreman over that department, but he seemed to think Loftus was a sort of "crank," "so different from the rest of the men, you know," said he.

By the way, I am not perfectly satisfied with Brailey as a foreman. He is ambitious to get on and all that, but he is not my ideal; he is too much of a plunger, and I have to take excuses too often instead of results. I have tried to discover the proper niche in mechanical work where he would be suitable, and where I can place him without destroying his ambition.

But to get back to Loftus. Jack got into a habit of talking to himself, shaking his head, and then hitting some inoffensive casting a vicious blow with his hammer when he would partially regain his normal condition.

Matters came to a focus two weeks ago when he came in and said he wanted to "talk" with me. He said, "I want to get off for about two weeks or ten days; I've spoken to the foreman, and he says you can't spare me; now I want to have my say and then you can have your say. Probably you have noticed on your going home from the shop evenings that little woman and the two babies sitting on the door step of the little house on the corner of B street. Well, they are mine, as we call it, and I have a scheme. I know a man who went down to the sea-shore last summer and got good board and lodging for only one dollar a day, so I have held back all my overtime and extras for the past four months, and I have sixty dollars that my wife don't know of; I am going to take her and the babies to Rockaway and let them roll in the water and dig in the sand while the sixty lasts, and see what the effect will be. I've written to a Mrs. O'Brien for board and made all arrangements. I don't imagine that we will have rooms en suite with bath attached; neither will we be served at tables by servants of polished ebony with white apron trimmings, but we will have an opportunity to see the ocean and taste the saltiness thereof and forget, as it were, all about belts and pulleys, and the daily grind of shop and household duties, and see if things won't go easier after we come back. What do you say, do I get off?"

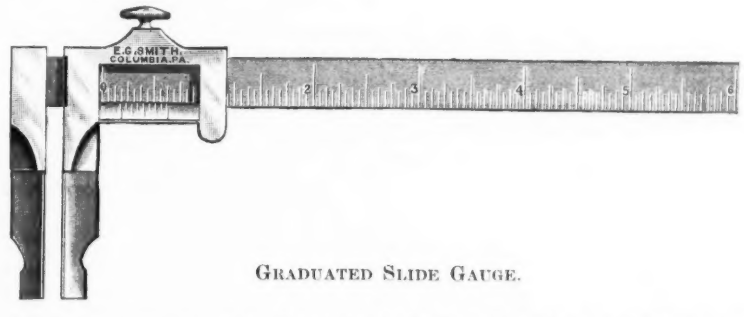
I had noticed the little woman and two babies as Jack expressed it, although one of the "babies" was a sturdy little chap of five years whose sole aim in life seemed to be to get the family cat hung on the front gate. I recalled the faded, tired look on the face of the little woman as she talked baby talk to the pale restless infant in her arms while awaiting the husband's evening home coming.

Jack had never gazed upon the ocean and I had. Judging from my own experience in days gone by I did not think his "sixty" would go very far, but I was interested in seeing the experiment worked, so I said: "Jack, your scheme looks so good that you can lay off while the sixty dollars holds out, and I would like also to invite myself to go along with yourself and Mrs. Loftus on this seaside outing. It may be beneficial for me also to commune with nature instead of mechanics for a few days; would I intrude?"

Jack didn't faint away at my proposition, but recovering from the stagger it gave him, I was invited. We arrived at Rockaway on Thursday and found Mrs. O'Brien, notwithstanding the name, to be a rather cheerful woman of Connecticut Yankee stock, who kept the table loaded with good wholesome food and kept gallons of pure sweet milk for the babies to drink in her kitchen, while her husband was a jovial son of Erin, whose jokes kept everything lively. We rolled in the brine and the children burrowed in the sand after sand crabs until the baby was the color of a beet, while the five-year old looked like a Turk and had an appetite like an ostrich. Loftus spent the hours when out of the water sitting on the beach gazing oceanward until his eyes bulged out like opera glasses, while his timid little wife hunted shells and odd sea curiosities.

I didn't put in all my time in close companionship with him, and at the end of a week, when I suggested that probably they might find added pleasures spending the afternoons and evenings among the museums and concert halls, the flying Dutchman, the razzle dazzle, roller coaster, or as O'Brien puts it, "the roundy-go-boundy," and the hundred other attractions that take nickels from our pockets, Jack fired up and said, "Old Man, see the color in that woman's face? See those two kids? That's all we want; I can get all those other rackets at home if I want 'em; I came here to forget the earth and have my family enjoy salt water, sand and tan; we are doing it great."

I bothered him no more, but helped the two cherubs build sand castles and paddle in the breakers until the tenth day, when Loftus packed his grip-sacks, and, taking the two babies in his arms, said, "Let's go." Bidding our generous hosts adieu we came through the great metropolis, and in the evening, after he had stowed his treasures away in their berths, he came into the smoking room of the sleeper where I was enjoying my cabbage leaf without sauce. As I gave him a cigar I asked, "Jack, how much over the sixty did it take?" "Two dollars and thirty cents less than sixty," he replied. "Pretty good scheme, hey? Think I'll take in the mountains next year."



GRADUATED SLIDE GAUGE.

Loftus showed up Monday morning as usual; instead of his previous "queer" actions there was a twinkle of contentment in his eyes Undoubtedly his scheme was a paying investment.

I believe every man and boy around the plant has been up to the cottage on B street, "hefted" the boy, admired the baby and complimented the blushing Mrs. Loftus on her improved looks. I also understand there is to be a general hegira to the sea shore next summer by the employes of this firm; from general manager down to the youngest cub. I also notice a slight improvement in both quality and quantity in work produced in the shop. Yes, it paid.

"THE OLD MAN."

Graduated Slide Gauge.

We present an illustration of a tool intended to be used as a caliper and general gauging instrument, in which the vernier principle is made use of to accurately measure the 128th part of an inch.

The beam of the caliper is graduated to 16ths, and the vernier scale on the sliding jaw divides a space of $\frac{7}{16}$" into eight equal parts, thus giving 128ths of an inch, which are readily read off with accuracy.

The outside of the jaws at the extr mities are ground just $\frac{7}{16}$" in diameter, so that by taking the opposite end of the vernier scale for the initial point and reading in the opposite direction, inside measurements are obtained with equal accuracy, without the necessity for using two scales or making allowance for the thickness of the jaws.

All parts of the gauge are made of steel and all wearing parts hardened, the jaws being accurately ground parallel and at right angles to the beam. A spring under the clamping screw keeps the sliding jaw in uniform contact with the beam.

No mechanic who has ever used a slide gauge will need to be told their peculiar advantages for many kinds of work, and this one, with its facilities for "splitting 64ths," ought to find favor, especially with those who do not like the decimal system of division. The calipers are made in five sizes from 4" to 12" long by E. G. Smith, Columbia, Pa.

A Female Stage-driver.

A peculiarly nervous little woman, with dark auburn hair and flashing black eyes, is often registered at the Grand Hotel in this city. She is Mrs. H. J. Langdon, of Lassen County, the woman stage-driver of the Sierras; but she is more than a driver of stages, she is an owner. Her stage lines extend for several hundred miles throughout the mountains, and she owns scores of horses and vehicles, and carries the United States mail as well as hundreds of passengers.

Her husband died a few years ago, and she took hold and managed and extended the business aforesaid. Mrs. Langdon has taken many mail contracts from the Government, and is well known at Washington, D. C., which city she often has occasion to visit in connection with her mail contract. Recently she had some correspondence with Postmaster-General Wanamaker in regard to his method of awarding contracts, in which she expressed herself in a manner to attract the attention of the entire country.

Mrs. Langdon is reported to be as good a judge of stock as any man in the stage business. She knows also the opportune moment when to grease a wagon, oil harness, and generally to keep in touch with the stage business, so as to make it successful.

Her stage lines extend over some of the ruggedest routes in the Sierras and again across plains, like those about Susanville. Plumas County has several of Mrs. Langdon's lines. She delivers mails and passengers promptly, and by reason of her skill in taking contracts and her ability in executing them has become noted for her pluck and enterprise. She is said to be an excellent whip, and to be able to manipulate the lines of four or more horses about as easily as the famous Hank Monk used to do on the old Geiger grade.—*San Francisco Examiner.*

A dispatch announces that no more oil tank steamships would be allowed to pass through the Suez Canal. At the Standard Oil Company's office, 18 Broadway, it was said that the Standard Company had never sent oil to India by way of the Suez Canal.

The company had made application to the directors of the canal some time ago for permission to send oil steamships through there, and the decision has just been given adversely, as oil steamships were considered too dangerous.

Oil in cases will in the future be sent around the Cape, as in the past, and the decision of the canal directors will not affect the market any, nor will the Russian oil dealers gain any advantage from it, they say. Case oil is always carried to India in sailing vessels, as it is much cheaper.

The government has ordered built for exhibition at the World's Fair at Chicago a postal car equipped with all modern improvements, as a part of the United States postal exhibit. A portion of the sides of the car will be left open, and so arranged as to allow visitors to have a clear view of the interior without going inside.

Two double-decked ferryboats, with fore and aft screws, have been contracted for by the Central Railroad of New Jersey Company, with the Harlan & Hollingsworth Company, of Wilmington, Del., who expect to have the boats completed by January 1, 1893. The boats will be 158 feet over all, 54 feet wide over the guards, and 32 foot beam.

It is stated that secret instructions have recently been sent to the managers of all the Russian railways not to enter into contracts with foreign firms, nor to admit foreigners into their service.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

For Sale, Cheap—Patent of grip pipe wrench. Address B. F. Chappell, Quarryville, Conn.

Wanted lists of fittings, etc.; specity., design & superv'n, etc., mach'y. C. Mantle, 598 E. 134th St., N.Y.

Wanted—A specialty to manufacture either heavy or light work. We have splendid facilities. Address "Manufacturers," Rockford, Ill.

Agency wanted—A young, energetic mechanical engineer wants to represent some good firms for Buffalo and surroundings. Box 44, care AM. MACH.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

Wanted—To sell the entire right of my universal bench vise; best testimonials from pattern makers and others. J. F. Emmert, Box 313, Waynesboro, Pa.

For Sale—One Empire steam pump, 5" suction 4" discharge; one 2 horse-power Taylor sweep machine; will take foot power screw cutting lathe in exchange. E. C. Knowlton, Sackett's Harbor, N. Y.

Bound volumes for 1891. We are now prepared to take orders. Price, $4.00 per volume; express charges payable by purchaser. Address AMERICAN MACHINIST, 203 Broadway, New York.

We will pay 25 cents each for copies of the AMERICAN MACHINIST of December 25, 1886, issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Wanted—To manufacture something in the machinery line, anything to make a business; good thing to the right party to have their work made cheap. Address Jno. E. Collins, 20 Mill street, Watertown, N. Y.

LOOK AT THESE BARGAINS IN

SECOND-HAND MACHINERY.

ENGINE LATHES.

1 28 in. x 15 ft. Blaisdel, Plain Rest Raised to 36 in. Good order.
1 28 in. x 12 ft. " Compound Rest, Raised to 40 in. A1 condition.
1 26 in x 8 ft. Blaisdel Compound Rest Raised to 36 in. Good order.
1 16 in x 6 ft. Hatfield, Rise & Fall Rest.
1 15 in. x 6 ft. Blaisdel, " " " with Chuck. A1 condition.

PLANERS.

1 22 in. x 22 in. x 5 ft. N. Y. S. E. Co. A1 condition.
1 22 in. x 22 in. x 5 ft. Whitcomb. Good as new.

MISCELLANEOUS.

1 Barnes Sensitive Drill Press. Good as new.
1 Pratt & Whitney 6 Spindle Drill Press. A1 condition.
1 Garvin No. 4-4 Spindle Drill Press. " "
1 12 in. Gould & E. Crank Shaper. Good as new.
1 No. 3 Cincinnati Universal Miller, complete with Rack Cutting and Vertical Attachments and lot tools.
1 Ames Two Spindle Profiler, with Cutters. Good order.
1 No. 3 Pratt & Whitney Plain Screw Machine. " "
1 No. 2 " " Screw Machine, Automatic Chuck and Wire Feed. Good as new.
1 16 in. x 6 ft. Square Arbor Fox Lathe, with Chasing Box and set of Overtail Stock. A1 condition.
1 15 in. x 5 ft. Jones & Lamson Turret Lathe. " "

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ON HAND.

10 ft. x 10 ft. x 16 ft. Planer.		1 Head.
72 in. x 48 x 30 ft.		3 Heads.
72 in. x 48 ft. x 21 ft.	do	3 Heads, Detrick & Harvey, new.
62 in. x 48 in. x 17 ft.	do	1 do
54 in. x 42 in. x 24½ ft.	do	2 do
46 in. x 33 in. x 30 ft.	do	2 do
39 in. x 36 in. x 12 ft.	do	1 do
36 in. x 38 in. x 8 ft.	do	Powell A1.
30 in. x 30 in. x 7 & 8 ft.	do	1 Head.
26 in. x 26 in. x 6 ft.	do	1 do
25 in. x 24 in. x 6 ft.	do	1 do
22 in. x 21 in. x 5 ft.	do	1 do
50 in. x 30 ft. Bed Triple Geared.		New Engine Lathe.
48 in. x 22 ft.	do	do do do
42 in. x 17 ft.	do	A1 do do
36 in. x 24½ ft.		New Haven do do
30 in. x 28 ft.		D. W. Pond Shafting Lathe.
26 in. x 25 ft.		D. W. Pond Engine do
32 in. x 12, 14, 16, 18 ft. Bed.		New do do
28 in. x 12, 14, 16, 18 ft.	do	do do do
21 in. x 10, 12 ft.	do	do do do
20 in. x 7½ & 8 ft.	do	2d Hand do do
18 in. x 6, 7 & 8 ft.	do	New & do do do
17 in. x 8 ft.	do	do do do
16 in. x 6 & 8 ft.	do	do do do do
15 in. x 6 & 8 ft.	do	do do do do
14 in. x 6 ft.	do	do do do do

Car Axle Lathe, Bement.
9 & 14 in. Stroke Slotters.
15, 16, 18, 25 in. Crank Shapers.
20, 24, 26 & 30 in. Geared Shapers.
20, 22, 24, 28, 30 & 36 in. Drills.
Bolt Cutters.
2 Garvin No. 4 Millers, A1.
1 Brainerd No. 3 Miller, A1.
No. 5 Stiles Press, Geared, A1.

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ENGINE LATHES.

78 in. swing,	9 ft.	between centers		Sellers
38 do	17 ft.	bed. New		Fifield
30 do	14	do do		do
27 do	16	do do		
24 do	12	do do		Fifield
24 do	12	do do		Fitchburg
24 do	12	do do		Flather
22 do	10	do New Pattern		Fifield
22 do	12	do do		do
22 do	12	do New		Blaisdell
22 do	8	do do		Flather
21 do	10	do do		do
20 do	8	do do		do
20 do	10	do do		do
18 do	8	do do		do
18 do	10	do do		do
18 do	8	do do		Blaisdell
18 do	16	do do		do
16 do	6	do do		Flather
16 do	6	do do		Blaisdell
15 do	6	do do		Flather
14 do	6	do do		do
14 do	6	do do		Blaisdell
12 do	6	do do		do

PLANERS.

42 in. wide,	42 in. high,	12 ft. long,	2 heads	Gleason
36 do	36 do	8 do		Pease
30 do	30 do	8 do		do
30 do	30 do	8 do		Whitcomb
30 do	30 do	8 do		Flather
26 do	26 do	6 do		do
24 do	24 do	6 do		do
24 do	24 do	6 do		Whitcomb
22 do	22 do	5 do		do
22 do	22 do	6 do		Flather

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" "	14 in. x 6 ft.,	Taper Attachment.	Hendey.
" "	14 in. x 6 ft.,	Compound Rest.	Fitchburg.
" "	14 in. x 6 ft.,	Ashton Hand.	Good order.
" "	16 in. x 8-8-10 ft.,	Extra Heavy.	Hendey.
" "	16 in. x 6-8 ft.,	New, Heavy Pattern.	Fitchburg.
" "	16 in. x 6 ft.,	with Gdg. Att., Pond.	Good order.
" "	16 in. x 6 ft.,	Lathe and Morse.	" "
" "	16 in. x 6-8 ft.,	Special Low Price.	Standard.
" "	18 in. x 6-8-10 ft.,	C'p'd Rest, Taper.	Hendey.
" "	18 in. x 8-10 ft.,	New Heavy Pattern.	Fitchburg.
" "	18 in. x 8 ft.,	A-1 order.	New Haven.
" "	20 in. x 8 ft.,	Hollow Spin. Cross Feed, Late Pattern.	Perkins. Good order.
" "	20 in. x 8-10-12-14 ft.,	Low Prices.	Standard.
" "	22 in. x 10 ft.,	C'p'd Rest.	Perkins.
" "	24 in. x 12 ft.,	Old Style, Low Price,	Fair order.
" "	24 in. x 12 ft.,	C'p'd Rest, Putnam.	Good order.
" "	24 in. x 12 ft.,	" "	Perkins.
" "	24 in. x 12-14 16 ft.,	Compound Rest.	Standard.
" "	28 in. x 16 ft.,	Extra Heavy.	"
" "	32 in. x 12 ft.,	" "	"
" "	36 in. x 14 ft.,	New Heavy Pattern.	Fitchburg.
" "	66 in. x 24 ft.,	for Facing and Boring,	Low Price.

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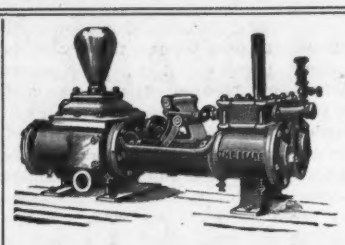

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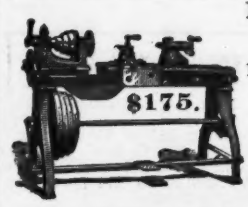

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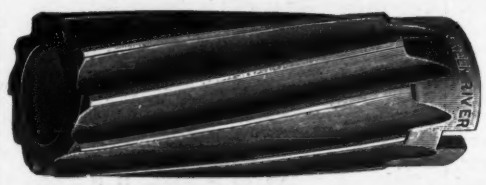

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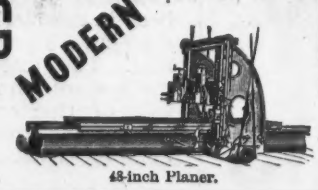
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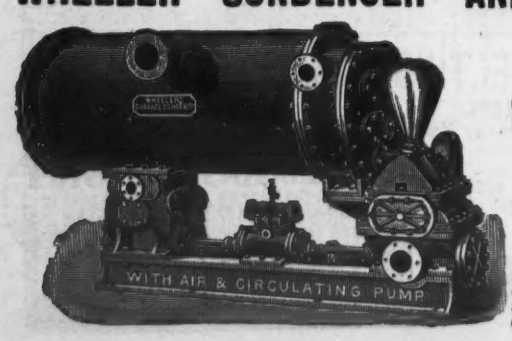

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